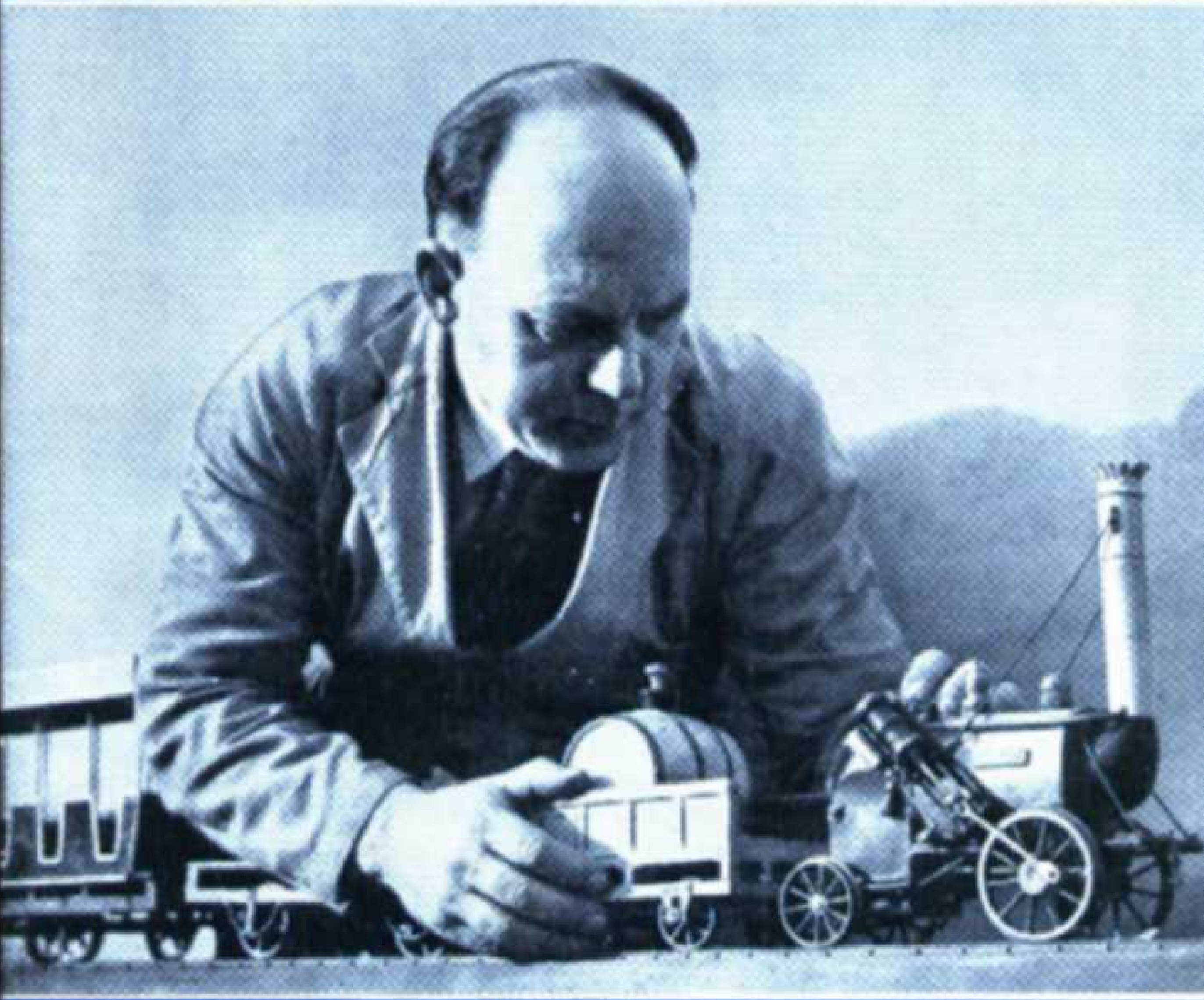
THE MODEL ENGINEER



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NOVEMBER 5th 1953
Vol. 109 No. 2737

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THE MODEL ENGINEER

ESTABLISHED 1898

EVERY THURSDAY

Volume 109 - No. 2737

NOVEMBER 5th 1953

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1·

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Our Cover Picture

The photograph reproduced came all the way from Australia. It depicts Mr. S. H. Milligan, secretary of the Surrey Hills Live Steamers, of Melbourne, with his 3½-in. gauge replica of Stephenson's *Rocket*, of 1829. We understand that this engine was built largely to the instructions given by L.B.S.C. for *Rainhill*, but was considerably altered so as to produce a very close copy of the *Rocket*. The photograph shows clearly the extraordinary degree of accuracy attained, which is all the more remarkable in view of the fact that the little engine was built about 12,000 miles from the *Rocket's* home! Mr. L. R. East, president of the S.H.L.S. has built another, but for 2½-in. gauge, and it is just as accurate a copy of the famous prototype.

SMOKE RINGS

The Birmingham National Rally, 1954

WE HAVE received from the Birmingham Society of Model Engineers an announcement to the effect that, for some time, visitors to the National Locomotive Rally at Campbell Green have expressed a wish that the event should be held earlier in the year, when the days are long. In view of this, the committee has decided to hold the next National Rally on June 26th and 27th, 1954. This news will enable intending visitors to arrange the dates in next year's summer programmes.

Exhibition at Cambridge

FROM October, 19th to 23rd the Corn Exchange, Cambridge, was the scene of the fourth post-war exhibition organised by the Cambridge and District Society of Model Engineers. Upwards of 220 exhibits were on view, arranged in eight separate sections, the strongest of which was the 4-mm. scale model railway equipment with 61 items. The variety was a very wide one, and a novelty was a section devoted to the work of the wives and female relatives of members, who succeeded in mustering 21 exhibits. Among these was a model aeroplane, a *Dolphin* tow-line glider made by Mrs. M. Reynolds; the rest were more the sort of thing that we should expect to find in this section, examples of needlework, embroidery, woodwork and pottery. But it was a happy idea to give this encouragement to our lady friends, and we suggest that other clubs might do more in this way. The Cambridge Model Aircraft Club collaborated and put up a splendid display of 47 model aircraft of all kinds.

His Worship the Mayor of Cambridge opened the exhibition, and we hear that the attendance was excellent during the five days of the show. The society is very unfortunate in being unable to have the use of the Corn Exchange on Saturdays. We suggest that this is a case where the local council might give careful consideration to the provision of a centrally-situated hall that would be suitable for exhibitions and other functions; the cost of building it should not require many years to recover.

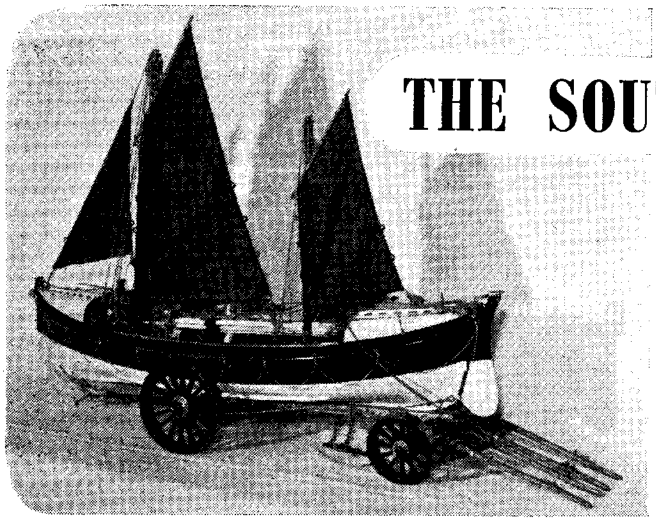
But, to get back to the point, it was a very enjoyable show in which the most intriguing exhibit was a fine 5-in. gauge diesel-electric shunting locomotive powered by a petrol motor for which the alternative power unit is a steam engine! So far as we are aware, this is quite an original idea.

The Late Mr. J. B. Skingley

WE LEARN with deep regret of the sudden death of Mr. J. B. Skingley, who was well known in model power boat circles, having been Hon. Secretary of the Victoria Model Steamboat Club for several years, and an active participant in the organisation and running of regattas in many parts of the country. Besides building and operating several boats, the latest being the motor launch *Josephine*, with a 4-cylinder "Seal Major" engine installed, he has carried out a great deal of research in timing equipment, and his original tape chronograph has been in use for many years. Mr. Skingley's family have all been keen power boat enthusiasts; his late father and mother were noted for their pond-side hospitality in the days before the war, and this tradition has been handed down. His brother, Mr. J. A. Skingley, collaborated with him in the early days, and his wife was well known as an expert with the stop-watch in timing high-speed events. Not only will the V.M.S.C., and other clubs with which he was associated, lose one of their most active and illustrious members, but his loss will be keenly felt by many personal friends in all branches of model engineering.

THE SOUTHPORT EXHIBITION

Reported by "Northerner"



Left: This ½-in. scale lifeboat, built by G. W. Hinchliffe, was excellently detailed and finished

AS might perhaps be expected from a seaside resort, the predominating influence at this year's Southport Exhibition was on the marine side, although aircraft and "OO"-gauge railways were well represented, too.

There were no fewer than three model lifeboats, and one of these, illustrated herewith, was awarded the Championship Trophy, as well as First Prize in its class. It was a model of a 36-ft. self-righting boat for pulling and sailing, and was complete with its launching carriage.

The detail and finish were very good indeed; the boat was fully equipped with oars, the rigging was complete with authentic blocks and tackle, and the paintwork had the neat workmanlike finish of the prototype.

Nor was the boat any better than its launching carriage, which was also very fully detailed. The main axle was a built-up curved girder, and the launching ways were of oak strengthened with metal plates. The fore carriage was also of oak with metal reinforcing plates, with a metal turntable. Wheels were built up with oak felloes and spokes, with steel tyres and metal hubs which were bolted through.

This was a most satisfying model, and the builder, G. W. Hinchliffe of Preston, must have spent a great deal of time in studying his prototype. Incidentally, I understand that he is now 85 years of age, and that this is the first time he has exhibited.

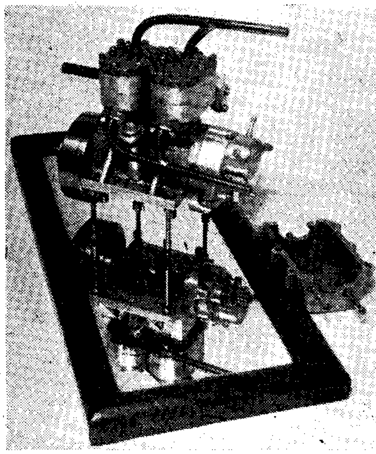
The other two lifeboats were built by another octogenarian, W. C. Adams, one of them having been awarded a First Prize and Challenge Cup at Manchester in 1934, as well as First Prize at the 1948 Southport show.

This model was commenced as long ago as 1896, and was finished for the British Empire Exhibition of 1924. However, it was not shown there, but it took part in the local celebrations of the Festival of Britain.

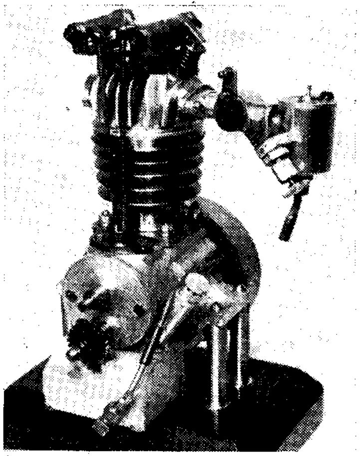
Again the detail was excellent—a typical example was the fact that Mr. Adams had made more than 5,000 copper rings for clinching the rivets of the clinker-built hull. The latter was not painted, but left "bright" to show the excellent finish of the timbers—oak planks and thwarts, American elm timbers and mahogany deck.

Metal Hull

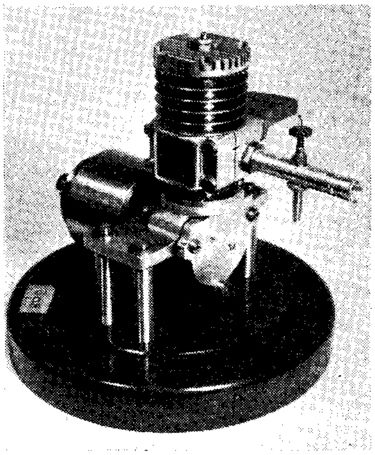
Also in the marine section was a metal hull by A. Riley of Southport, whose excellent motor yacht I reported at the N.A.M.E. Exhibition this year. This time Mr. Riley is



Mr. Riley's 10 c.c. petrol-engine had the crankcase removed, the "works" being reflected in a mirror



Built to the "Kittiwake" design, this 15 c.c. engine by J W. Jones was well finished



Another of Mr. Jones' efforts was this glow-plug engine for high-speed boat work

building a model, to $\frac{1}{8}$-in. scale, of the Swedish cargo passenger liner *Eric Banck*, from drawings and photographs kindly supplied by the owners.

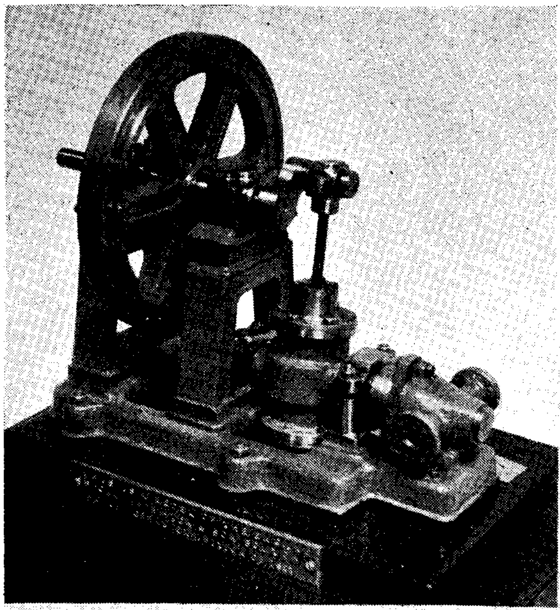
The ribs and keel of this shapely hull are cut from discarded curtain rail, and the plates themselves are cut from tin-cans—fruit, syrup, and so on. Mr. Riley's motor yacht was also exhibited, by the way, and won First Prize in the power boats.

The same builder also had gained a Second Prize for a twin-cylinder water-cooled petrol engine to his own design. It was of 10 c.c. capacity, with separate cylinders, and was well built and finished. Mr. Riley had made his own patterns, and these were on show with the engine. I understand that two of his friends are building engines to this design.

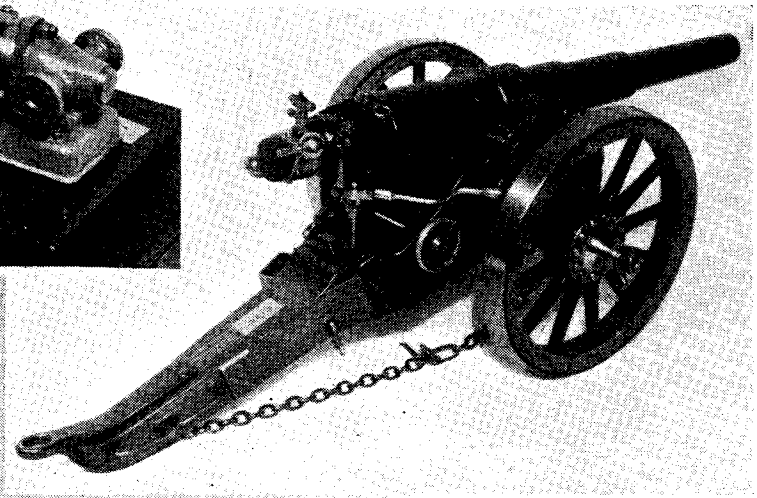
J. W. Jones of Maghull exhibited two engines, as well as a couple of hydroplanes, one of which has exceeded 45 m.p.h. Both engines were well finished, one of them being E. T. Westbury's well-known 15 c.c. o.h.v. "Kittiwake," fitted with mechanical lubrication, and the other apparently of the builder's own design, a 9 c.c. two-stroke for high-speed boat work, with glow-plug ignition.

We should not leave the internal combustion engines without mentioning the Southport lads' rail-type Grand Prix car-track, which readers may remember was one of the highlights of the N.A.M.E. show this year.

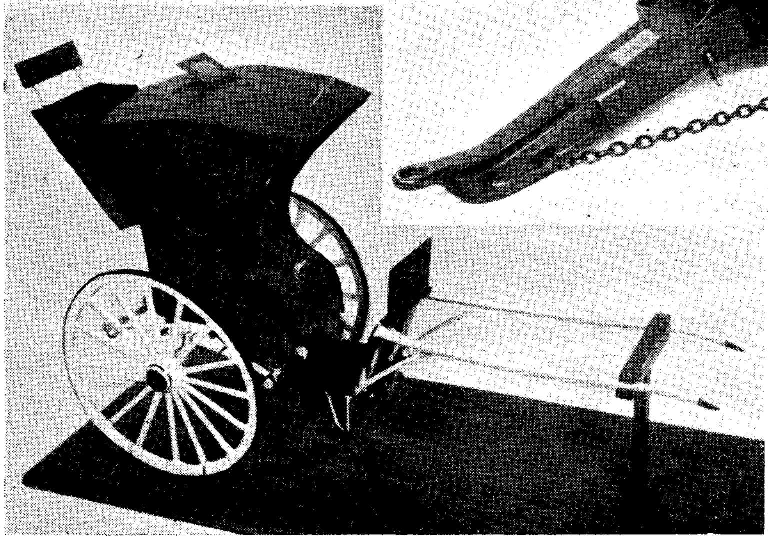
W. Sephton, of the home club, won a real Grand Prix—120 laps—on the closing night of the show, with his Auto Union. Normally, the "driver" of this car appears to steer the car round the bends, leaning over as he does so, but when I saw the vehicle he had been removed in favour of the larger fuel tank necessitated by the length of the race.



Left: An unusual prototype—the Hick oscillating engine of 1851—was chosen by J. Shaw, of Bolton



Below: One of three guns exhibited by G. W. Hinchliffe, this 40-pounder was very fully detailed



Model of a hansom-cab exhibited by a schoolboy, John Prescott of Southport

An "Emett" Layout

Cartoonist Emett has tickled the fancy of many people with his railway fantasies, and Mr. Sephton is among the modellers who are bringing his cartoons to actuality. (Of course, Southport has almost a proprietorial interest in Emett, since the Festival Gardens locomotives were built in the town.)

This young man has made a start on a 4-mm. scale Emett layout with a locomotive and carriage, a station building, and a car complete with driver. These models are well detailed with just the right atmosphere, and the whole layout should be a joy to the beholder when finished. The locomotive was shown at work on the club's "OO"-gauge

(*Continued on next page*)

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with :

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Meshing Gears

I am constructing a small cake mixer, the blades of which are to be driven by an electric motor by means of gearing, and I have obtained from a friend three steel gears of suitable size. Owing to the design of the casing, it is not possible to fix the positions of the two outer gears by meshing and marking-off. Is there any simple method for determining the gear centres by direct measurement?

S.A.M. (Romford).

The calculation for finding the correct centre distance of two meshing gears is extremely simple, as it is necessary only to add together the number of teeth in both gears and divide the sum by twice the diametral pitch. Thus, for instance, the correct centre distance for two gears of 40 teeth each, and of 20 diametral pitch would be :—

$$\frac{40 + 40}{40} = 2 \text{ in.}$$

In your letter, however, you do not give any particulars of the gears, and it seems possible that you do not know the diametral pitch.

This can be found by another simple calculation, viz.:—

Add two to the number of teeth and divide by the outside diameter.

Thus, for example, given a gear of 40 teeth and a diameter of 2.1 in. the diametral pitch would be found as follows :—

$$\frac{40 + 2}{2.1} = \frac{42}{2.1} = 20 \text{ diametral pitch.}$$

Miniature Slide Projector

I am proposing to build the slide projector (double frame) as described in THE MODEL ENGINEER *for* 1950. *I intend to use a mains lamp (230 volts a.c.). What is the largest wattage I can use without blower or heat filter?*

Mr. Westbury brought his projector to the Hull M.E. Club about two years ago, and it was a grand job, but I forget what bulb he had.

E.M. (Hull).

We are of the opinion that a 200 or 250 watt mains lamp, running on 230 volts, could be used in this projector without the use of a blower, but a heat filter would be advisable for anything over 150 watts.

It should be noted that the actual illuminating efficiency of a high-voltage lamp in such a projector is much less than one of equivalent wattage run on low voltage owing to the fact that the filament cannot be so compactly arranged and there is thus a good deal of light wastage.

With reference to the "M.E." projector which was used at a meeting of the Hull Club the lamp in this case was one of 50 watts only, running on 15 volts through a transformer enclosed in the base of the instrument.

Petrol Engine Castings

Could you please tell me where I may obtain castings of a model 4-stroke petrol engine of between 10 and 20 c.c.? A 10 c.c. o.h.v. engine called the "Channel Islands Special" was on the market but I have been unable to find an address from which I may obtain same.

E.S.B. (East Cowes I.O.W.).

Castings for the "Kiwi" and "Kittiwake" 15 c.c. engines are obtainable from G. Kennion & Co., 32, Kingsland Road, London, E.2. Castings for the "Seal" 4-cylinder, 4-stroke petrol engine and also the "Seagull" 10 c.c. twin-cylinder engine can be obtained from Craftsmanship Models Ltd., Circle Gardens, London S.W.14.

With reference to the 10 c.c. engine known as the "Channel Islands Special" this was manufactured by Messrs. J. & G. Jenson Ltd., of Jersey, but is not in production at the present time. We understand however that stocks of castings for this engine are still held by Precision Model Engineering Co. Ltd., Paradise Street, Liverpool.

THE SOUTHPORT EXHIBITION

(*Continued from previous page*)

layout, which was in another room. This large scenic track was much admired by the visitors; it certainly was impressive, especially in view of the fact that it had been built and brought into operation within a few months only.

Other Models

A very nice, and quite unusual, model was the oscillating engine built by J. Shaw of Bolton, who is, I believe, only 17 years of age. The prototype was built in 1851, and shown at the Great Exhibition by the makers, B. Hick and Son, of Bolton.

The flywheel is mounted on two A-frames, the overhung crank being driven by the oscillating cylinder, which also is supported by two bearings, with the valve-plate outside. This was an extremely interesting model, and was well made and finished, though it would have looked better with cast-iron flywheel and cylinder-ends, instead of gunmetal.

Mr. Hinchliffe, whose lifeboat has been described, had also three model guns on view, one of them a quick-firer, being between two and three feet tall. One of the others was an old-type naval 24-pounder, and the third was the 40-pounder Armstrong gun pictured here.

Like the others, this gun was full of excellent detail, with a good finish. The gun was breech-loading, with a rifled barrel, and was fitted with screw elevating-gear, complete with a dogged lever. The carriage was of oak, with correctly built-up wheels.

Last, but not least, was a section for exhibitors from 11 to 14 years of age, in which a typical model was the hansom cab built by John Prescott of Southport. This appeared to be constructed of thin card chiefly, with a few parts in wood. The roof had an opening ventilator, and the interior was upholstered in blue cloth. Other very creditable work in this class included a small country station by Bryan Mayo, model aircraft by M. J. Bamber, and a coastal cruiser by J. E. Sephton.

L.B.S.C.'s Lobby Chat

● A UNIQUE MOTIVE POWER DEPOT

NOW and again, I get a tale of woe from somebody or other, whose locomotive has deteriorated by virtue of his having to keep it in an outside workshop, or some other place where rust and damp have played havoc with it. If I suggest keeping it indoors, the usual answer is, that the domestic authorities raise objection, on the grounds that there is no suitable place for it, or that it is no ornament, or some such invalid excuse. To keep the peace, the unfortunate and inoffensive piece of motive power is banished from the house, and the British climate then proceeds to do its worst. Thank goodness that the above doesn't always apply; some wives and mothers are proud of their husband's or son's efforts, and welcome the fruits of his patient labour to a place of honour in the house.

However, a locomotive can be easily stored indoors, without being an "eyesore," or giving offence to any unsympathetic person, or occupying space which may be required for other uses. A couple of boxes could be made, to contain the engine and tender; these should be just large enough for the engine to be run in from the end, doors being provided for the purpose. Carrying handles of leather or fabric belting, should be fitted to the top, so that they will lie flat when the boxes are not being handled, and allow of one box being placed on top of the other. It will be hard luck indeed, if some place cannot be found to "park" the boxes, even under a bed, or a table, or behind a door, where if not exactly "out of mind," their presence would cause no inconvenience!

This trouble has never worried your humble servant; but something else has! My workshop, as the few who have seen it well know, is a shining example of how a quart can be got into a pint pot; and it would be an absolute impossibility to keep any locomotives in it, in addition to its complement of machinery, tools, material, and what-have-you. Fortunately, I am able to use the first-floor back room directly above it, as a general office for writing, drawing, and correspondence. It was intended for use as a spare bedroom, but as we have no use for one, it came in just right for the purpose mentioned. There is a recess in one corner, nearly 5 ft. long and 1 ft. deep; and in that, I fitted a series of stout shelves, like book-shelves, which accommodated sixteen locomotives of various sizes. I also fitted a large mantelboard on the shelf over the fireplace, and an extra one a little above that, supporting them with iron shelf brackets; the former was the usual resting-place of *Tugboat Annie*.

Tom Glazebrook driving "Red Hen" at Toronto

Hard Labour

When we first came to live here, over 23 years ago, I was a little more sprightly than at the present time, and it didn't seem very burdensome, to carry the engines up and down a flight of rather steep stairs, the treads of which were rather narrow. My feet aren't of the size usually associated with the police force, being only a fraction over 9 in. long, although I am 5 ft. 8 in. in height, and weigh over 160 lb. Talking about police, an old P.C. friend, long since retired, used to say with a chuckle, that when he applied for the job, the first question asked was what size boots he wore. On replying "Twelves," he was told "You're all right—we don't take anything smaller than tens!" Anyway, I found it was easy to keep a footing on the 9½ in. stair-treads, when carrying a heavy engine; and for many years, matters went like wedding-bells. There comes a time when *anno Domini* takes its toll; and for the past few years, it has definitely become "hard labour" to carry the locomotives up and down, the blessed stairs seeming to get steeper and steeper. I, therefore, began to cast about for an idea which would enable me to keep the whole lot of engines in the realms below.

But how to do it? That *was* the problem! My workshop was out of the question, for reasons stated; our hacienda is small, and there was no available space in either of the other downstairs rooms (living-room and kitchen) nor in the entrance hall. I considered a shallow cupboard alongside the wall, but even that was out of court, as

the hat-and-coat stand monopolised one side, and a radiator was in the middle of the other. There matters remained, until suddenly, like a bolt from the blue, the solution presented itself.

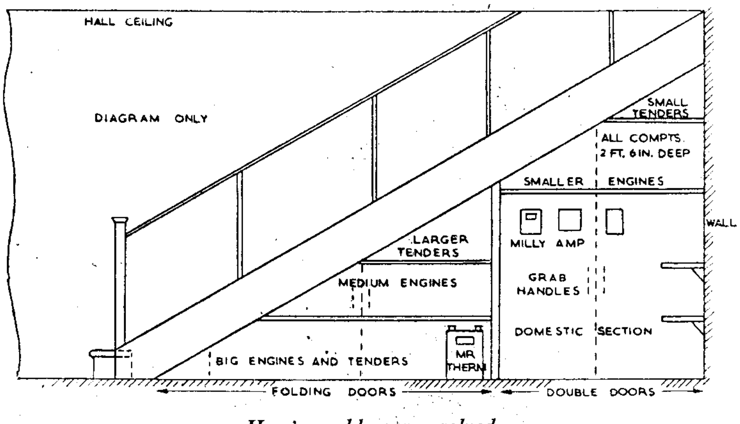
A Spot of Decoration Needed

Our house had a rough time during the six years of bloodshed and destruction; in fact, the house next door was hit one night by an incendiary bomb, and burnt to a shell, which didn't improve ours. After it was over, a war-damage-repair contractor had a go at putting us to rights; but all he apparently worried about, was getting the job done as quickly as possible, and drawing the cash. Personally, I didn't worry myself overmuch at the time, as we considered ourselves mighty lucky to get anything done at all ! But as time went on, the place deteriorated, and at last I approached a friend in the building trade, Mr. L. T. Truett, who built the original L.M.S. "2F" class 0-6-0 tank engine, and made a most excellent job of it, which worked as well as it looked. He said that his firm, Truett & Steel, Ltd., would do the needful as soon as they could spare the men. In due course, the outdoor manager came along to see what was needed; and when discussing the painting of the staircase, something prompted me to remark that they were far too steep for comfort, and I wondered if the firm could fit a new staircase on an easier grade. The outdoor manager said he would see the head of the joinery department about it; and to cut a long story short, that worthy telephoned me later in the afternoon, made a date to call and inspect matters, did so, took measurements, and sent me a drawing of a proposed new staircase which would fill the bill.

Then came the brain-wave—why not use the space under the new stairs, for a locomotive-shed ? I returned the drawing, said it was O.K., and asked if the space below could be fitted with doors for the full length, and some strong shelves put in. The reply was, as they say at Westminster, in the affirmative, so I gave the green light.

The New M.P.D.

The space under the original staircase was little more than a cubby-hole containing the gas and electricity meters, main switches, and fuseboxes; it also came in handy for the domestic brooms and brushes, vacuum-cleaner, etc. Naturally, these had to be accommodated in the new layout; but this was easily arranged, owing to the far greater "cubical capacity" available. The diagram shows how things were arranged. A partition was placed between the gas and electricity meters; and a shelf, 4 ft. 6 in. from floor level, allowed ample space below it, for domestic purposes, two small additional shelves being fixed in the space, for sundries. On the side containing the gas meter, the height of same, and the connecting pipes, settled the height of the lowest shelf, which will carry six 2½-in. gauge locomotives. On the floor below, is space for the big 2-6-6-4 Mallet *Annabel*, and three more of the heavier engines; it is, of course, handiest to keep the bigger locomotives at the lowest level, for lifting purposes. They take some humping off a high shelf ! Two additional shelves, located above those mentioned, provided adequate accommodation for the lighter 2½-in. gauge jobs, and old *Ancient Lights*, still leaving room for the experimental jobs now under way. I still hope to complete these ere I say farewell to this benighted planet !

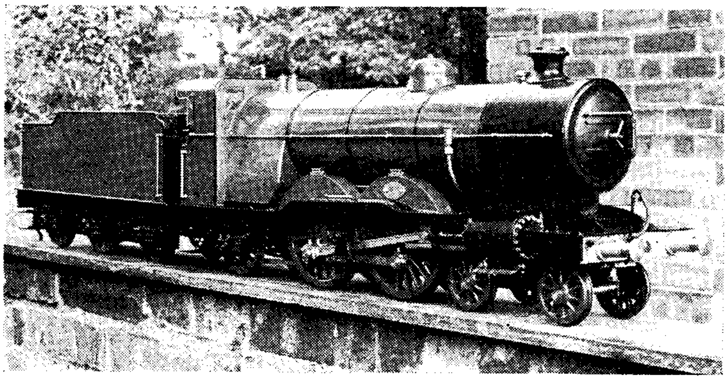


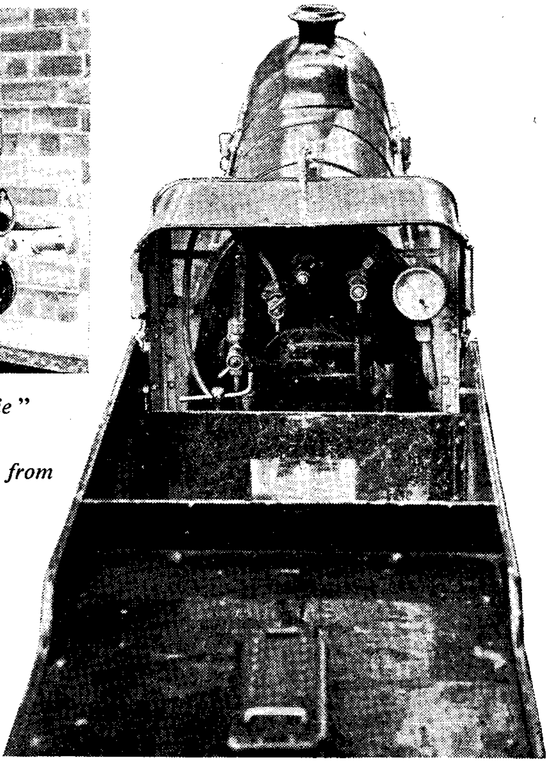
How a problem was solved

The larger section, containing the domestic share of the available space, has ordinary double doors; the smaller one has one long door which folds in the middle when opened, and swings back flush, allowing plenty of room to get the engines in and out. When the doors are closed, the engines are well protected from dust, are in a dry and warm atmosphere, and while completely "out of the way," are instantly accessible. They can be lifted out with a minimum of exertion; and carrying up-and-down the stairs, is a thing of the past. At time of writing, the new M.P.D. has only been in use for a few weeks, but has already proved a great boon. The space under any existing staircase could be utilised in a similar manner, by fitting the necessary doors and shelves. I might mention that when the gas-man recently called to read the meter, he took an awfully long time to get the figures correct, and had to look at the index four times before entering the "therms" on the card. Maybe he was a little shy of *Annabel* !

After 27 Years

Readers frequently ask how long they could expect a little locomotive to run, before needing repairs or overhaul; so maybe the following will interest them. My old 4-12-2 *Caterpillar* began to derail at speed, and perform a few more untoward antics, so I decided to give her a birthday treat, and do a few needed jobs. For new readers' benefit I might recall that she, too, was the result of an impulse. One hot afternoon in July 1926, I was sitting by the window of the upstairs room which I used as a workshop at my old home at Norbury. This room faced SW. and used to get terribly hot in summer, with the result that I frequently suffered from severe headaches. I had a peach of a one on that particular afternoon, and was trying to get rid of it by aid of a cup of the enginemen's best friend, and aspirins. Looking at a picture of the then new Union Pacific (U.S.A.) three-cylinder 4-12-2 which I had hung on the wall a short while previously, I fell to wondering what sort of a job she would be if built to British outline, and thought that I'd dearly love to bring about 150 loaded coal wagons from South Wales up to London with her, and show the lads of the Great Western, that although their engines were good, there WERE others ! ! Then I remembered certain engines that had been run on club and exhibition tracks, and thought what a smasher she would





Mr. C. Wilkins's "Maisie"

Right: "Maisie" seen from the bridge

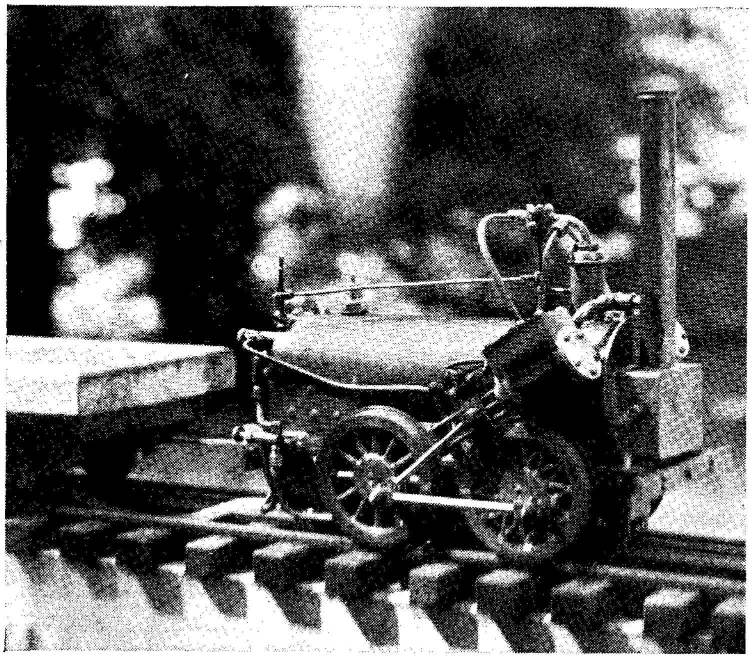
make if built in the small size. She would make the before-mentioned engines look very small potatoes indeed. Then came the startling thought—what is to prevent my building her in the small size? I drank up my tea, forgot all about my headache, and started right away, leaving the job which I had been doing. At that time I only had a 52 ft. straight line in the back garden laid to 2½-in. gauge, so that settled the size. I needed no drawings, and by 11 o'clock that night, the frames were cut out and erected. In four weeks she had passed her road tests, and 43 days from the time of conception, she was finished. I fitted four cylinders instead of three, as I wanted to try the eight-beat 135 deg. crank setting; and I built the boiler to stand a working pressure of 175 lb. if necessary, so that she could easily lick anything hitherto put on 2½-in. gauge, for hauling capacity. I called her *Caterpillar* because she reminded me of those insects, with her long boiler-barrel with the string of little wheels under it.

The engine came fully up to expectations, and at the Model Railway Club's exhibition in the following spring, she took her turn with the bigger engines on the passenger-carrying track, hauling ten adults at a time. The biggest load she ever pulled was at a Boy Scout "do" near Birmingham, when she hauled a mixed load of sixteen passengers, Scouts and adults. This was done with 110 lb. of steam, plus a bit of sand. She never needed the 175 lb., but usually ran at 90. She pursued her merry course, trouble-free, until at last, on one fine day, I took her to the late Bro. Wholesale's line at Bursledon, in Hampshire. Just after passing over his high-level bridge, and applying brakes for the down grade, she ran off the road and pitched clean off the trestle, taking the car and your humble servant with her. I wasn't hurt, except for severe nettle stings; neither was the car, and apparently the engine hadn't suffered either, as we cleaned the dirt off her, and she ran several more trips. Incidentally, the cause of the derailment was never discovered until after Bro. Wholesale had departed to the land beyond the veil, and I ran the car on my own road. I found that when the brake was applied hard (the brake gear was somebody else's brainwave) it caused the car bogies to slew around, and upset the applecart.

In the Shops

The years rolled on, and so did the *Caterpillar*, until, as mentioned above, she became unsteady; so when an opportunity arose, I partially dismantled her and held a "post-mortem." I found that the cradle under the firebox had been twisted, apparently by the fall, and had worked loose, which accounted for the milk in the coconut. This was soon put right; but while she was "in the shops," I thought it would be a good wheeze to do a few more needed jobs. She had run from the start, with a drum-type displacement lubricator with adjustable feed; when she was built, I had not done any experimenting with mechanical lubricators. The displacement lubricator did the job all right, but needed careful adjustment, to avoid "gulping" and yet maintain an adequate supply of oil. Too much opening of the oil-valve, well and truly christened the driver and passengers; so the drum gadget was removed, and one of my "standard" mechanical lubricators fitted in its place. This has a 3/32-in. ram, and is driven from one of the inside eccentric-rods, giving a constant supply with no need for adjustment. One filling lasts about 1¾ miles, with the pump working pretty fast, as the coat-button-size driving-wheels spin like buzz-saws when the engine travels at express passenger speed, as she usually does.

When new, she had two eccentric-driven boiler feed pumps, each $\frac{5}{16}$ in. bore × $\frac{3}{8}$ in. stroke. I knew how fast the boiler could evaporate water; and being a human being, thought that if I wanted to do a bit of "showing-off," I'd better be on the safe side! However, the steam consumption of the four cylinders, even with ten-passenger loads, was much less than anticipated; and one pump proved capable of maintaining the water level under all conditions of service. The pumps had separate bypass pipes and cocks, so could be used alternately. To simplify matters, I took off the pumps, lined up the bores to $\frac{3}{16}$ in. by means of bronze sleeves turned to a push fit, made new rustless-steel rams to suit, and new glands. The two bypass pipes were cut short, and connected just beyond the pump unions; a single pipe ran along to the



Mr. R. Paul's "Invicta"—a long way from Canterbury!

drag beam, and a vertical screw-down valve, with a brake-type handle, replaced the two cocks. Even these weeny rams can put in more than the boiler needs, but regulation is now very easy.

The engine originally had one of the larger-size injectors, described in the early days of these notes, and in the first *Live Steam Book*. When I introduced the smaller type, I fitted one with adapters to fit the larger unions, and installed it in place of the original. I have now removed the larger steam valve, clacks, and pipes, and substituted the size recommended for my "standard" injectors, so that I could use the *Caterpillar* for injector testing, if required. She also has a duplex donkey pump; and I found that both the studs holding it to the boiler were broken, presumably by the fall, and the pipes had apparently been supporting the gadget ever since. That little bit of trouble was soon remedied. The donkey still works O.K.; but in passing, let me tell you this—that if anybody tells you that he can get a weeny donkey-pump to work *under steam* at a speed as low as 12 strokes per min. just call for the salt-cellar. It is possible with air pressure; with a tyre pump, I can make the one mentioned above, run so slow that the pump rods hardly move, but it is impossible with steam, for reasons which maybe I will explain in a future lobby chat.

As one opening of the Girl Guide chime whistle was muffled by the blobs and gadgets under the foot-plate, and the whistle squawked in very un-Guidelike fashion, I took it off and substituted a big single-note whistle. Replacement of a couple of broken handrail pillars, and a few small adjustments to the motion, finished the job, as far as the "works" were concerned. The cylinders and motion are showing signs of wear, but not bad enough for replacements yet. The boiler had a good washout, and the old girl runs all the better for her "birthday treat." She doesn't run off the road any more.

Picture Gallery

One of the reproduced photographs shows an old friend in a new setting, viz.: Tom Glazebrook at the Live Steamers' meet in Toronto. Bro. T. G. has shaken the dust of England from his feet, and gone to live at White Plains, N.Y., having been appointed to the executive of the Underwood concern, with an office in New York City; so he now "commutes" on the New York Central, instead of the Southern between Thornton Heath and Victoria! Good luck to him. I happen to know White Plains quite well, used to visit the roundhouse in the old steam days. There was a cat there, with an appetite like an ostrich; the only thing it ever refused to eat, was garlic!

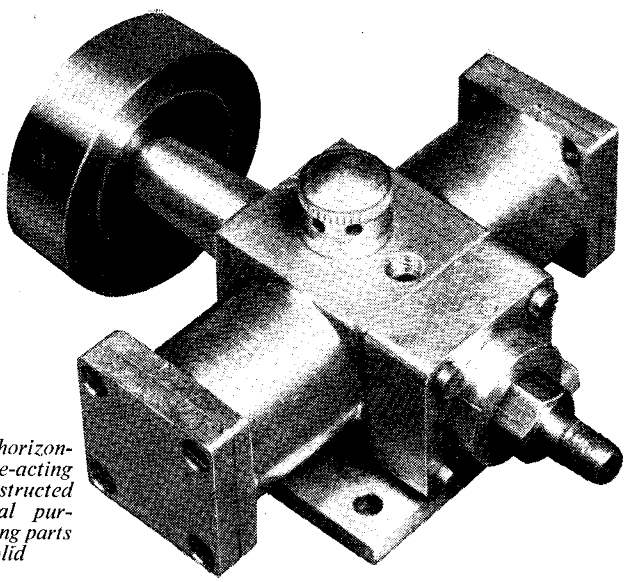
The fine example of a *Maisie* engine was built by Mr. C. Wilkins, a member of the Romford club, and a Local Government Officer, who has already built a *Dyak*, and says that locomotive-building affords just that relief which he finds necessary in his official job. The photographs were taken by Frank Markham, another member whose name is known to followers of these notes. As the engine part is built to the "words and music"—note the studs in the cylinder covers—there is no need to describe her in detail; but our worthy friend has included some later refinements, such as Ross-type safety-valves, and snifting-valve on the smokebox. She also has a modern straight-sided tender, which personally I consider a great improvement, though if I had made one for the original *Maisie*, my good friend Bill Massive would have had forty fits. The engine performs as well as she looks, and certainly calls for high commendation.

I mentioned some time ago, that *Invicta* locomotives were springing up all over the world, and here is a picture of one in steam, built by Roger Paul, of Fall River, Mass., U.S.A. She differs slightly in detail from the published instructions, as can be seen from the blower, safety-valve and throttle lever, as she was partly made "ahead of schedule"; but details don't matter—it is *performance* that counts. This wee Kentish lassie, which has never seen Canterbury, and never will, can pull two adults easily, and licks a larger American-type "stable-mate" for free steaming, the safety-valve being usually in the condition shown. Can you imagine old Teddy Fletcher, who drove the original engine on the opening day of the Canterbury and Whitstable Railway in 1930, sitting on the car behind her, accompanied by Robert Stephenson, at whose works the original job was built? I'll bet that the look on their faces when Teddy gave the little one steam, and she promptly moved off with the pair of them, would have knocked anything that ever came out of Hollywood, into a cocked hat. The photograph was taken by George Murray, on his track at Manchester, Conn. Referring to the question of appearance versus performance, I have recently received some very interesting letters from both new and old readers on this subject, raising some very pertinent points, but must defer my comments for a future lobby chat.

MORE UTILITY STEAM ENGINES

INTRODUCING THE "CYGNET"

By Edgar T. Westbury



The " Cygnet " horizontal twin single-acting engine, as constructed for experimental purposes by machining parts from the solid

ONLY a few finishing touches remain to be dealt with to complete the " Unicorn " engine, and these are largely at the discretion of the constructor. This applies to such items as cylinder lagging, which in the case of a small engine, is fitted more for the sake of appearance than anything else. It is usual to lag the cylinder barrel, and indeed in an engine of this type it would look very bare without some covering; but if the object is really to conserve thermal efficiency, not only the barrel, but every part in internal contact with steam, including the cylinder covers, steam chest, throttle-valve, and steam pipes, should be effectively insulated; even then, the heat loss by conduction to other engine parts would be considerable.

The actual heat insulating material may be asbestos, slag wool, felt, flannel or any similar substance, held in place by an outer covering which, in the older engines, was usually of wood, in the form of carefully fitted battens. In later types of engines, blued sheet steel, or as it was termed, " Russian iron," was adopted, being much easier to fit. Either could be used in this case, but the appearance of polished teak or mahogany is very attractive, and this has been used in the engine illustrated. The battens are $\frac{3}{16}$ in. wide by $\frac{1}{16}$ in. thick, the edges being cut at a slight angle to fit closely together, and with a barely perceptible chamfer; they are held in place by two brass bands, $\frac{3}{16}$ in. wide by 0.015 in. thick, secured to the cylinder by 10-B.A. screws.

Cylinder drains are not a necessity on a small engine, but they assist in " warming through," and avoid the ejection of oily water from the exhaust when starting up. As shown in the general arrangement drawings, coupled drain cocks are fitted, though they are not connected to waste pipes as they would be on a large engine. The drain cocks used were supplied by Bonds o' Euston Road, and have drilled levers suitable for fitting the coupling-rod, also spring-loaded plugs which keep them steamtight, and with just the right degree of friction.

Oil cups and other small fittings suitable for this engine can be obtained from the same source, or from other " M.E." advertisers. It is, however, advisable to make a special oil cup for the crankhead bearing, in the form of a small angle-piece to screw into the keep-plate; on no account should it be clumsy or obtrusive.

After the engine has been tested, it should be stripped and cleaned, all working parts being inspected to see that they are bedding in nicely, and the structural parts—after thorough degreasing—finished by painting. It is advisable to take care with this, and despite the claims of " one-coat " enamels, it will be found best to apply at least two coats of undercoating or filler, before the finishing coat of hard gloss enamel. Incidentally, the colours chosen for stationary engines are usually " neat but not gaudy," and among the most popular were sage green, slate colour or medium grey; the latter, by the way, is the most " photogenic " colour I know, and having been obliged to cope with the problems of photographing models, I wish it were more commonly employed.

As the height of the crankshaft centre, from the bottom of the bedplate, is considerably less than the radius of the flywheel, it is clear that the engine will either have to be mounted on a raised plinth, or a pit for the flywheel will have to be provided in the engine-room floor. The former is the more common for stationary engines of small or moderate size, and also has the advantage of showing the model off well. There has been some discussion on the matter of realism in engine foundations, and I do not propose to rush in where angels fear to tread; but I will merely state that in my experience, most engines of this period were usually mounted on plinths built from dressed stone, or ashlar, as it was termed, though this largely gave way in later years to concrete. I have mounted my engine on a solid wooden plinth, scored to imitate the joints in the stone blocks, and painted cream (light stone colour would be equally suitable) which, as can be seen in the previously published photographs, is fairly effective.

On no account should one make the very common mistake of trying to make the engine look like a model of a very large one, by putting it in a totally out-of-scale environment, such as by fitting railings or other furnishings which would only be appropriate to an engine two or three times the size, and of a totally different character. So far from enhancing realism, these methods destroy every vestige of it; the discerning observer will not be favourably impressed with a mixture of scale effects which suggest that

Continued from page 491, *October* 22, 1953.

the engineer would be twelve feet tall or that the cylinder nuts would be two feet across flats! As a matter of fact, the engine represented by this model would have a cylinder bore of about 6 in. diameter and a stroke of 10 in.; any intelligent reader can work out for himself the size any accessories or furnishings should be. By all means fit railings or any other embellishments you fancy—but let them be true to scale.

The "Cygnet" Flat Twin High-Speed Engine

The next exploration into steam engine design which I propose to deal with might possibly be considered as going from the sublime to the ridiculous, since it makes no claim to be a representative model of any full-size engine, but is intended simply to do a job of work. In external appearance, it is austere and possibly unattractive, but its internal design, and methods of construction, are very interesting, and it certainly gave me a good deal of pleasure in the making; I hope, therefore, that it will appeal to many other readers.

It might be said with some truth that this engine owes its existence mainly to the fact that I managed to acquire (more or less honestly!) a piece of duralumin, ⅞ in. square by a little over 2½ in. long. For some time I had been cogitating on the possibility of producing an engine to fill the demand expressed by readers for something "new, simple and efficient," and this bit of metal gave me ideas. When I first got down to work on it, my intention was really to use the engine as a "guinea pig," to test out and use in the development of a finished design; but it has worked so well, and has excited the interest of so many people, that I have decided to present it in this form, even if I improve upon it later.

I do not propose to make extravagant claims for this design; when I say it is "new," this applies only to the particular form and arrangement, as it would be extremely difficult to produce anything really new in the *principles* of steam engine design nowadays. Many readers, no doubt, will recognise in it the rebirth of an old idea which was usually carried out very inefficiently in its day. I claim to have improved on this in several details, and made it efficient; but this term, also, must be considered in a relative sense.

Practical Efficiency

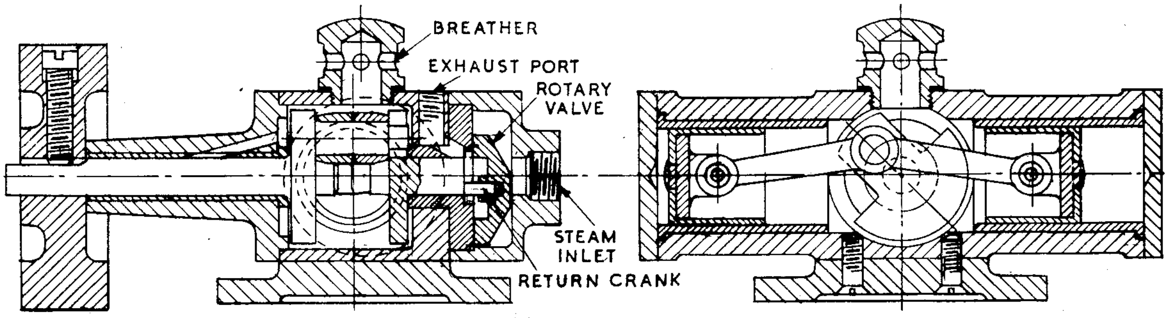
A few words on the subject of efficiency in small engines may be appropriate here; it has been dealt with several times before, but is still very imperfectly understood. There are several "departments" of efficiency—mechanical, thermal, volumetric, etc.—and for an engine to be efficient in the true sense of the term, all these would have to be taken into consideration. It is well known that all small engines, both steam and internal combustion, are grossly inefficient, when considered in the relation between the energy theoretically put into the engine in the form of fuel, and that obtainable in the form of actual shaft horsepower. When we talk of a "high-efficiency engine" we usually mean one which packs into a small space and weight, a large amount of power; but such an engine may have, and often has, a lower efficiency than one of more modest power output.

In engines used for driving models, power in relation to bulk and weight is much more important than *thermal* efficiency; within limits, we can afford to be extravagant with fuel, provided that we can obtain the power we require. In order to do so, it is usual to force up the *volumetric* efficiency—in other words, the power output in relation to engine displacement—by increasing either the working pressure or the speed, or both. But in doing so, the loading on all the working parts, and therefore the friction, is inevitably increased, and other things being equal, the *mechanical* efficiency is thereby lowered. In some cases a state of affairs may be reached where the two cancel out, and increase of pressure and speed produces no more useful power at the engine shaft.

The Virtue of Simplicity

I am convinced that this happens in many cases, particularly in engines of complicated design, having elaborate valve gear "designed for efficiency," or cumbersome reciprocating parts which cannot be effectively balanced. It follows, therefore, that simplicity, and lightness of working parts, are highly desirable features, if they can be attained without involving other disadvantages. There is a story of a well-known designer whose golden rule in design was to "simplicate and add lightness." Other things being equal, the simpler and lighter the working parts of an engine, the better it will work.

But simplicity, if carried so far as to impair functional design, can be, and often is, fatal to efficiency. The simple oscillating engine, for instance, has only three working parts, but it can never be efficient, because it cannot distribute its steam efficiently, and also because, in most cases, the friction on the valve port face is excessive. It is possible to reduce the number of working parts in a double-acting engine to two, and obtain correct steam distribution, but in this case a cumbersome form of piston is usually involved, and the connection between this and the driving shaft is mechanically inefficient.



GENERAL ARRANGEMENT

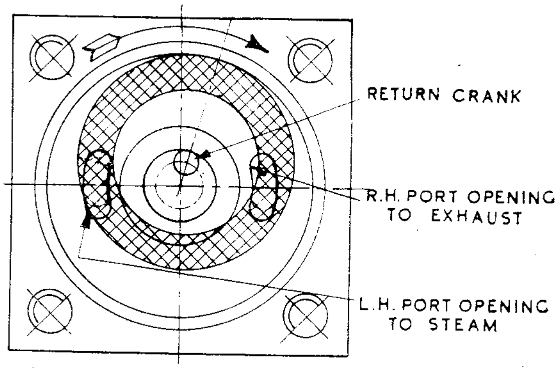
Wastefulness in steam consumption cannot be tolerated in cases where the size of the boiler is limited, such as in a model power boat; it follows, therefore, that steam economy must be one of the most important factors in plant efficiency. It is true that one often hears boasts that "the safety valve blows even with the engine flat out"—but that simply means that the capacity of the engine is not properly balanced to that of the boiler.

These points are mentioned to justify my claim that the engine to be described is capable, if properly made, of working with a high degree of volumetric efficiency; the reason is that its working parts are few in number, light in weight, and adequate in bearing surface, while the steam distribution is as exact and well-timed as in the normal slide-valve type of engine. The proof of the pudding is in the eating; and the fact is that when spun by hand, the engine gives the impression that it has no pistons or connecting-rods; it can be blown round at 500 r.p.m., and on 20 lb. per sq. in. steam pressure, produces 6,000 r.p.m., running light. (Higher pressure on no load is not considered discreet !)

Working Principles

As will be seen from the general arrangement drawings, the engine has an overhung crankshaft, the single crankpin of which operates both pistons through connecting-rods, the two ends of which are offset so that they clear each other, the cylinders being in axial alignment. This is not an ideal mechanical arrangement, but the offset thrusts are not serious, and the worst effect it is liable to have is a slight increase in bearing wear. Neither are the pistons dynamically balanced against each other, but this is not important in small engines, and in any case, would not be possible in conjunction with the method of steam distribution employed. The engine may be considered as comparable to a normal single-cylinder double-acting engine, having the cylinder divided transversely in half, to allow the crank to be interposed in the centre instead of in the usual position, with suitable modifications to pistons and other working parts.

In these respects, the engine resembles the "Venturer" poppet valve engine which was described in the first series of articles on "Utility Steam Engines"; the essential difference between the two engines is in the form of valve-gear employed. It will be seen that the valve is of the rotary type driven from the end of the crankpin by a floating return crank, and located in a steam chest on the back end of the crankcase.



ENLARGED VIEW OF VALVE PORT FACE
CROSS-HATCHING SHOWS AREA COVERED BY VALVE WHEN L.H. PISTON IS AT I.D.C

This type of valve has often been used in the past, one of the most notable exponents of engines so arranged being Mr. H. H. Groves, who used them over 40 years ago in speed boats and steam-driven model aircraft. The results which he achieved with them were remarkable for the time, and his engines have never been surpassed for design, workmanship and lightness. They were usually fabricated from sheet steel and tubing, by brazing or silver-soldering, and would stand up to superheated flash steam. Many other constructors emulated Mr. Groves, and the type of engine became adopted for running on compressed air, but it got a bad name, as it was often badly constructed, of poor materials, and with inadequate bearing surfaces. The steam (or air) passages to the cylinders were often in the form of bent pipes, of quite unnecessary length, the volume of which caused a good deal of pressure wastage. Similar engines were made with three or more cylinders arranged radially, with a single central distributing valve, but they have long since gone out of fashion, though specimens of them turn up occasionally at exhibitions.

In the design of this engine, I have sought to incorporate all the most practical features of the early types, while adding a few improvements of my own. There is no doubt that the use of a centrally-located valve helps to promote mechanical efficiency, by eliminating the need for eccentric-rods and articulated valve rods; it has, however, a minor disadvantage, in that the passages from the valve-ports to the cylinder are liable to be longer than is desirable. The passages must necessarily be large enough in cross-sectional area to avoid restricting the flow of steam, but excessive length increases the effective cylinder clearance volume at the inner end of the piston stroke, and thereby wastes a certain amount of steam; moreover, it increases the heat loss to the surrounding metal.

These effects can, however, be minimised by keeping the overall cylinder length short, which is done by reducing the length of stroke, and in this case, the stroke is only $\frac{3}{8}$ in., in relation to $\frac{1}{2}$-in. bore. Short-stroke engines are fashionable these days, and there is much to be said in their favour for high-speed engines, as they reduce the linear piston speed in relation to r.p.m.; but it should be remembered that they also reduce crankpin leverage, and increase bearing pressures on all working parts.

In the design of the rotary valve, I have introduced a rather unusual feature in that the valve, while moving in a circular orbit, does not necessarily rotate on its own axis, though it is free to do so. The older types of rotary-valve steam engines had ported valves which were positively rotated, usually through some form of floating drive which did not interfere with the ability of the valve to find its own seating; the ports were segmental, the steam port on the outer edge, opening to the steam chest, and the exhaust port inside, communicating with a central cavity in the valve-port face.

While the arrangement, and the stationary port layout, is similar in this engine, the valve is made circular, with an inner cavity, and a central hole which engages with the pin of the return crank. The advantage of this is in the mechanical operation, as it will clearly be seen that whereas the normal form of rotary valve must necessarily have a fairly high *peripheral* speed near its outer edge, the free circular valve does not necessarily have a higher surface speed anywhere than the

(*Continued on page* 547)

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

TESTING ENGINES ON OXYGEN

DEAR SIR,—*Re* the warning by Mr. J. Corbett of Yeovil, in the issue of September 24th, far be it from me ("L.B.S.C.'s" Lancashire correspondent) to say anything to detract from the well-meant warning of the horrible consequences of substituting oxygen for compressed air in large-scale practice. Had a description of the apparatus and pressure used in the unfortunate accident been given instead of the gory prospects and results, a better comparison could have been made with a small-scale model running on a 24 cu. ft. oxygen cylinder.

However, if in the future (distant I hope), Mr. Corbett hears tell of the welcoming by the "Red Monarch" of the lower regions of a chemist, astride a $3\frac{1}{2}$-in. *Invicta* propelled there by the amount of oxygen in the model *Invicta's* cylinders, at the pressure available through a fine adjustment valve and rubber tubing (compare with c/i explosions of some model diesels), he will be justified in saying: "Told him so."

Yours faithfully,

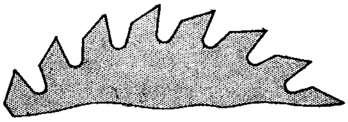
Southport.

"LANCASHIRE CORRESPONDENT."

CIRCULAR SAW SPEEDS

DEAR SIR,—Surely in your answer to F.T. of Croydon (issue dated September 10th) in regard to circular saw speeds, you have slipped up. I am retired now, but all my working life I have used circular saws, and I have never seen one going at the speed you give.

But to be more practical, some four years ago, I built a circular saw bench with rise and fall spindle, using scrap and the junk-box for material. The only saws I could buy were cut with triangular teeth, similar to a handsaw. From my experience I knew this tooth was no good for serious work—only for fine cutting of thin stuff such as 3-ply. I had by me part of a broken two-handed crosscut, and out of this I cut three 6 in. circles and ground in the teeth I wanted (sketch herewith). By allowing the front bearing of the spindle almost to come through the top of the bench, I was able to get a good 2 in. of blade showing above. The saw is driven by a $\frac{1}{4}$ h.p. Newman Imp a.c. motor, with a $3\frac{1}{2}$ in. vee-belt motor pulley, and a 3 in. saw pulley (motor revs. 1,425). These saws cut hard and soft wood easily and perfectly to the full depth, and on several occasions I have cut 4 in. stuff both hard and soft (oak and spruce) by taking a cut to the full depth of saw, then turning the wood over and meeting it.



My brother, when he saw my bench, asked me to make him one to be driven by a Wolf Cub drill. The experience I had gained in making and using my own bench enabled me to design and make a bench with rise and fall spindle a great deal simpler than my own

I fitted a small countershaft to which the drill was connected, and a single clamp held the drill. I reversed the pulley sizes this time—3 in. on the countershaft and $3\frac{1}{2}$ in. on the saw-spindle. He bought a 9 in. saw, with handsaw-type teeth, of course. I ground these off and reset the saw with teeth as shown, and this saw, although not quite as powerful as a proper machine, cuts 1 in. stuff *easily*, and has often cut up to 3 in. using care.

I think these two examples show that F.T. need not instal big h.p. motors or run the saws at fantastic speeds, provided he gets the right shape of tooth.

Yours faithfully,

Sychtyr. C. GAUNT.

FAULTY FIGURES ?

DEAR SIR,—If R. Mackie, of Luton, who complains of my alleged faulty maths. ("Readers' Letters," 8/10/53), will take the trouble to read my article of September 3rd *properly*, he will find he is talking through a hole in his hat !

The article did not say anything about using the foot as a basic scale: my concern was to point out how to "translate" from 1-in. scale to $1\frac{1}{2}$-in. scale. And if Mr. Mackie will take a rule marked in *twelfths-of-an-inch*, as I suggested, he will find (unless his maths. are different from those hammered into me by a succession of perspiring, but determined schoolmasters) that the twelfths represent inches in 1-in. (1/12) scale. Similarly, on a rule marked in *eighths-of-an-inch*, the latter divisions represent inches in $1\frac{1}{2}$-in. ($\frac{1}{8}$) scale.

So, as I said in the article, 7/12 (of-an-inch, not a foot) in 1-in. scale equals $\frac{7}{8}$ (of-an-inch, not a foot) in $1\frac{1}{2}$-in. scale, and both equal 7-in. in full size. Perhaps "represents" would be a better word than "equals," but this is splitting hairs anyway.

In passing, Mr. Mackie's own letter contains a couple of slips, the first being that he has not quoted my exact words, but has inserted the word "in." behind the "7/12" and "$\frac{7}{8}$" of the quote. Not that that matters, but I hope that, as a stickler for accuracy, Mr. Mackie will slap his own wrist hard for doing so.

Secondly, he says—"if you use two different scales, i.e., 1/12 and $\frac{1}{8}$-*in.*, (my italics—W.J.H.) you are bound to get different results." I'll say you are !—because, in my humble brand of maths. at least, $\frac{1}{8}$-*in.* scale is interpreted as $\frac{1}{8}$-in. to 1 foot, or 1/96 of full size ! *Quite* different from 1/12 scale, or even $\frac{1}{8}$ scale, which I imagine is what he means in that sentence.

To conclude, if I might presume to offer Mr. Mackie a word of advice, it would be first, to read an article *properly* before taking up the cudgels; and, secondly, not to drop clangers himself in doing so.

Yours faithfully,

Sheffield. W. J. HUGHES.

CYLINDER LATCH KEYS

DEAR SIR,—In reply to Mr. Keller's letter in the issue of THE MODEL ENGINEER dated September 17th, it would appear that his main concern is not with the model engineer or handyman (have it which way he likes), but whether he is going to lose the sale of new locks, through his customers obtain- the knowledge to cut their own keys !

If he had thought a little more he would have realised that the article would increase the sale of blank keys, suitable files and drills, and possibly new locks as well, if the homeworker could not make a job of cutting his own.

I have opened these locks, without cutting any part of the housing or other part, for the last thirty years, in probably the same way as his locksmith colleagues, but for the homeworker, the method described is the simplest. Regarding the different blanks available, it is *his* job as an ironmonger's assistant to see that the customer gets the right key blank for his cylinder.

I have used the cutting angle stated without trouble. I am well aware there are variations of this, but I am also aware that the cutters supplied with the key-cutting machines for this purpose are not always put on the machine spindle correctly, and revolve slightly out of the truth sideways, thereby producing a combined angle far from what it is supposed to cut, and the keys have worked sufficiently well to operate the lock.

In any case, why not let the model engineer or homeworker think and act for themselves, as without doubt their skill generally, is equal to most instrument workers—in some cases greater—and far exceeds anything ever likely to be required in an ironmonger's shop.

Yours faithfully,
Twickenham. G. E. CAPPS.

MOLE DRAINING

DEAR SIR,—After reading Mr. W. J. Hughes', article on " Traction Engines at the " M.E." Exhibition," I am wondering if his remarks on the method of mole draining with cable tackle are correct.

Surely it would be impossible to thread pipes on a tail rope attached to the mole, and in fact I have never seen or heard of this being done. There is, however, a machine that does lay pipes, but it is not worked by double engine tackle, nor is it a mole drainer.

Mole draining was usually performed when the sub-soil was plastic, since it was difficult to pull the mole if dry, and the drain soon collapsed. If the work was done under correct conditions the life of the drains, unlined that is, was up to seven years.

The drains were always drawn uphill, and the implement worked in one direction only, i.e., it was not of the " turning variety " as were cultivators and harrows. The return rope from the implement was attached to an eye in the hub of the engine hind wheel. The opposite engine hauled on a direct rope.

As with all operations performed by cable tackle, it was better that the ground was slightly soft, so that the engines sank a little, and were thus better able to resist the heavy side pull of the rope.

The front end of the engine, being lightest, was the first to slew round when going became hard, and the front wheel always had many grooves where the rope cut into it.

One of the most important features of cable engines was the coiling gear, since once the rope crossed on the drum it soon became crushed and broke. The gear was most cleverly driven on the Fowler engines by an eccentric end to the drum stud bush. If a different diameter rope was put on a drum it failed to coil correctly, since a given size of drum would hold only a given number of coils per layer, and the coiling gear was designed accordingly.

Yours faithfully,
Edgware. G. F. A. GILBERT.

MODEL STEAM PLANTS

DEAR SIR,—I would be very much obliged if any reader could let me know the name and address of the makers of the Beacon water gauge glasses which have a red line on a white background, and the water magnifies the red line. I have used these glasses for 40 years and more, but my supply has run out especially in the $\frac{3}{16}$ in. and 7/32 in. o.d. sizes. The last supply I had was from a firm in Glasgow, but they are now out of business. Any information on this subject will be very much appreciated.

Yours faithfully
Edinburgh. W. M. ROBERTSON

MORE UTILITY STEAM ENGINES

(*Continued from page* 545)

speed of the return crank. In practice, it creeps round on its own axis, distributing wear evenly, and avoiding the tendency to score, which is prevalent in ordinary forms of rotary-valves when operated under high pressure.

In other respects, the valve behaves in much the same way as an ordinary flat slide-valve, and its events, including lap and lead, angle of advance, etc., can be laid out on exactly the same basis, though there is some slight difference in the rate at which the ports open and close. As in the case of the slide-valve, it is pressed on to its seating by the steam pressure, and its friction increases as the pressure is raised. Owing to the order of its movement, however, the force required to move it is relatively small, and in the event of an engine designed to work at very high pressure—several hundred pounds per sq. in., say—it could be partially or completely pressure-balanced by modifying the design to incorporate a contra-piston.

The enlarged drawing of the valve port face clearly illustrates the action of the valve, the annular flat surface of which controls the steam admission by its periphery, and the exhaust by its inner cavity. In these respects, its similarity to an ordinary flat slide-valve is apparent.

In order to further the aim of high mechanical efficiency, particular care has been taken to provide ample bearing areas for all working parts, and to use suitable bearing material. Experience has taught me that for reducing friction, there is nothing to beat good old cast-iron, and I have properly " gone to town " in the use of this material for main bearing, cylinder liners, pistons, port face and roatry-valve; the only exception is the connecting-rods, which are of duralumin and run direct on the crankpin and gudgeon pins. Not only does cast-iron help to reduce friction, but it also enables the engine to withstand high temperature, and it can be run on superheated flash steam, so long as it is not so excessively hot as to reduce the mechanical strength of the light alloy used in the structural parts. In spite of its sturdy construction, the entire engine, as shown in the photograph, weighs only 4 oz.

The processes in the construction of this engine are fairly straightforward, but will be found interesting, I trust, by many readers. No doubt some will think that the simplicity of this design hardly merits the fanfare with which I have introduced it, but it is so rare to encounter any design which has the least novelty about it that I feel sure this one deserves its share of popularity.

(*To be continued*)

Repairing a TAP WRENCH

By " Duplex "

WHERE a square-ended tap is gripped in the type of cross-handled tap-wrench illustrated, the jaws are forced apart when turning pressure is applied to the tap, and this, in turn, imposes a bursting strain on the knurled thimble closing the two chuck jaws.

If this strain becomes excessive, the thimble may be torn open at its mouth, and the resulting damage will take the form illustrated in the photograph. Damage of this kind may be caused by ill-usage, and the thimble at the right of Fig. 1 was split in an attempt to grip a round-shank tool by forcible tightening of the threaded collar.

Although this occurred more than *fifty* years ago, the tool is still serviceable, as the damage is confined to the extreme end of the thimble. The smaller thimble in the centre of the photograph has, however, split and opened out to such an extent that the wrench will no longer hold a tap.

Apart from wrong use, the damage clearly results from the thimble being too thin at its mouth to resist ordinary working strains.

Rather than discard one of these somewhat expensive tools, it was decided to make and fit a new thimble of stouter proportions, and the new part is shown in place on the wrench at the left of the photograph.

Machining the New Thimble

No dimensions are given in the following account, as these will, of course, vary with the size of the wrench under repair. However, for the most part, the old thimble can be copied, except that the outside diameter of the coned end is made larger, but not to the extent of appearing clumsy. As a guide to the proportions, scaled, sectional drawings of the old and new thimbles are shown at *A* and *B* respectively in Fig. 2. The sequence of machining operations is represented in Fig. 3, but, before starting, it is advisable to make a dimensioned drawing or sketch of the part to serve as a working guide. Where the axial drilling operation greatly reduces the strength of the part, and leaves only a thin wall, it is safer to knurl the work before boring.

A length of mild-steel rod, gripped in the self-centring chuck, is turned parallel and faced at its end for centre-drilling and then drilled to the diameter of the thimble mouth. Next, the bore is enlarged to the tapping size, and the thread is formed with a tap guided by the tailstock drill chuck or by the back centre.

Well-finished Knurling

Unless this has been done previously, the body is now knurled and, if the method described in former articles is adopted, there should be no difficulty in obtaining a satisfactory result.

The question of poorly finished knurling always seems to be cropping up, for one sees so many examples of this in both amateur and commercial work. However, if good quality knurls are used, in a holder designed to press the opposing wheels against the work, so as not to stress the lathe mandrel, good knurling can hardly fail to result, provided that ordinary care is taken. Commercial concerns have the advantages of using expensive machinery and employing experienced tool-setters; in this connection, it is interesting to compare the knurling on the thimble in the centre of Fig. 1 with that produced in the small workshop and shown at the left of the photograph.

To obtain a well-finished clear-cut appearance, it is essential that the knurling should be continued until the tips of the small pyramids are brought to a sharp point, and if necessary, a hand-glass can be used to get a clearer view of the work. Apart from the lack of depth in

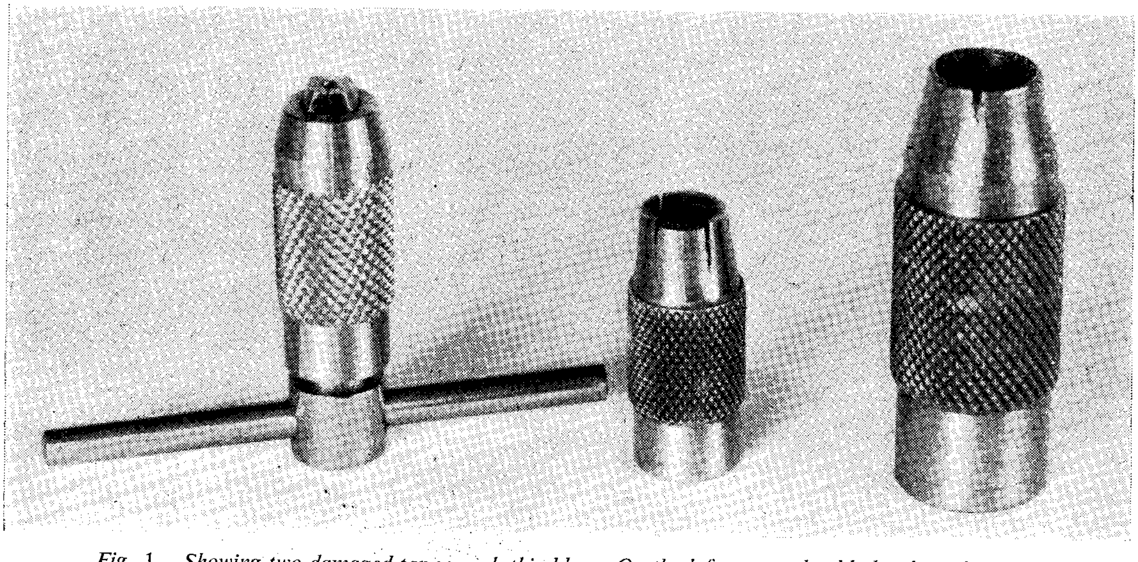


Fig. 1. Showing two damaged tap wrench thimbles. On the left, a new thimble has been fitted

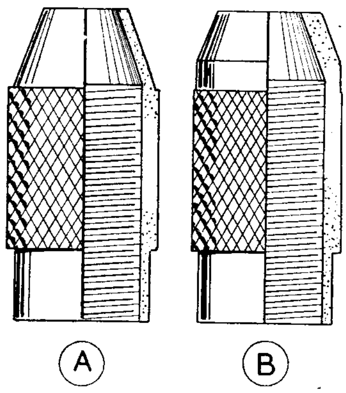


Fig. 2. Part-sectional view of, A, the original thimble, and, B the new part fitted

machining, some roughly finished knurling seems to be caused by the chips being rolled into the work surface.

Therefore, before starting, clean the knurls thoroughly with a stiff brush, and try to knurl to the full depth by making a single passage of the wheels over the part. This is not always possible when forming coarse knurling on steel parts; but, again, cleaning the wheels from time to time during machining will help to disperse the chips.

Opinions differ with regard to the use of cutting oil as an aid to knurling steel parts. In practice, merely applying a small amount of cutting oil with a brush seems to invite the chips to cling to the work and not fall clear, with the result that the swarf is rolled into the knurling and a poor finish is obtained.

On the other hand, a stream of cutting oil, under pressure, removes the swarf as it is formed and, by this means, well-finished knurling is more readily produced. Wire-brushing the finished knurling sometimes improves the appearance, and sand-blasting certainly gives an attractive finish, but neither process is necessary if the machining has been properly carried out.

After the thimble has been knurled, the work is machined with a V-tool to reduce the length of the knurling to cover only the middle portion of the thimble, and also to chamfer the edges of the knurling.

The coned seating within the thimble for closing the jaws of the wrench is machined by setting over the top-slide to the required angle, and a small boring tool is then used to take a series of light cuts with the lathe running at high speed. With the top-slide at the same setting, a knife tool is substituted for the boring tool, and the external, coned surface is machined so as to leave an adequate wall thickness at the mouth of the thimble.

The component can now be parted off and, to impart a good finish to the end face, the work is reversed in the chuck and a light facing cut is taken. When gripping knurled parts in the chuck in this way, the surface of the work should be protected from damage by a wrapping of thin card. If properly-set, sharp tools have been used throughout the machining, accompanied by the liberal use of cutting oil, the work should be left with a high finish. The use of emery cloth for finishing turned surfaces, such as these, should be avoided, as it is a sign of indifferent workmanship and is readily detected by experienced mechanics, including judges of competition exhibits.

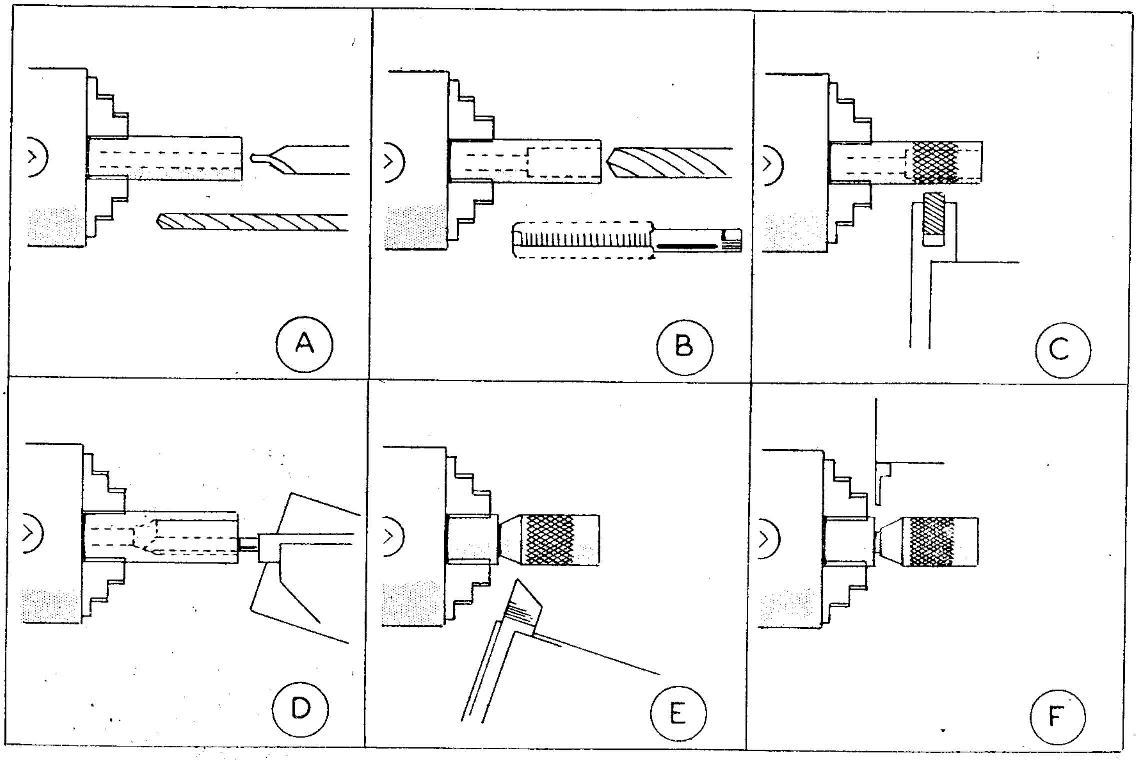


Fig. 3. The sequence of operations in machining the new thimble

BRITISH CRAMPTON LOCOMOTIVES

By E. W. TWINING

PART 7

THERE was a little point in connection with the mechanical design of the third pair of wheels of *Liverpool*, which the writer intended to refer to, in his last article, but by an oversight omitted to do so. He would like to call the reader's attention to the fact that the outer faces of the tyres of all the wheels were in line, but that the width of the tyres in the third pair; in other words, the widths of the tyres of the third was no greater than the width of the tread only, in other wheels. This should not have been so; the third pair of tyres ought to have been given the same widths as all the others, even though they were flangeless. This is an important point to which, so far as the writer is aware, attention has never been called before, and yet it seems that it may have been the cause of spreading the gauge of the track—if such spreading did actually take place.

A Swivelling Bogie

Even though one of the third pair of wheels did not drop quite off the rail, on a curve, it could have become almost derailed; sufficiently so to put a tremendous shearing force on the inside radius of the head of the rail. Of course, everyone knows, now, what should have been done in this engine; the group of four leading wheels should have been arranged as a swivelling bogie, as Daniel Gooch did in his broad gauge saddle tanks for his own line and for the South Devon Railway. And there we leave the *Liverpool* and pass on to the next British Cramptons: a batch of six, built by E. B. Wilson & Co. of Leeds, a famous firm who designed and built the numerous class of " Jenny Lind," 2-2-2 singles.

These six Cramptons, all alike, are illustrated in Figs. 16 and 17, in front and side elevation. One of them went, in 1848, to the North British Railway and was numbered 55 in the books of that company. The other five were for the Eastern Counties, afterwards the Great Eastern Railway. Just which company were the first to take delivery is uncertain, but it may be presumed that No. 55 was the first out of Wilson's shops, for this reason: The E.C.Rly. numbered their five engines, 108-9-10-11 and 12. Now No. 108 was delivered in October 1848, Nos. 109 and 110 in November, and Nos. 111 and 112 in December of the same year, it follows, therefore, that as No. 55 was also delivered in 1848 it must have been completed before the Eastern Counties batch, since it could not very well have been constructed after E.C. Rly. No. 112, in December.

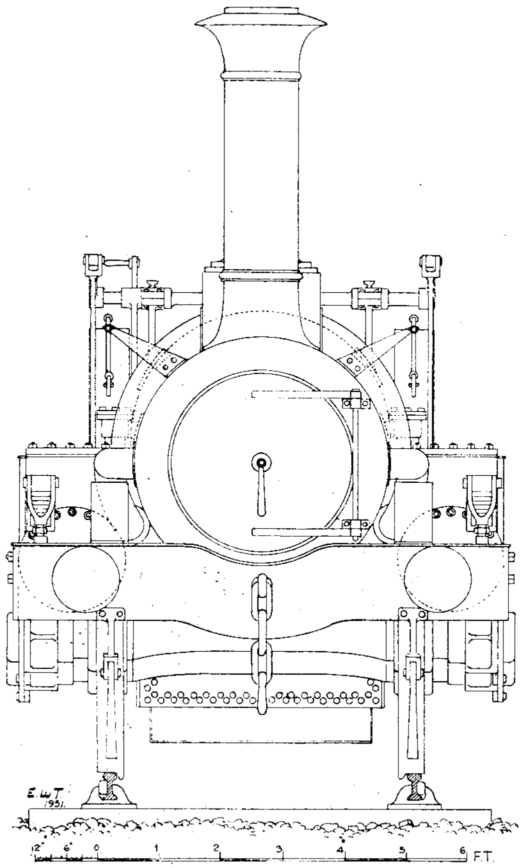


Fig. 16. Front view of the Eastern Counties Railway Crampton locomotive

Few particulars seem to be available regarding these engines. Those of importance which are known, are as follows: Wheel diameters, leading 4 ft. 6 in., intermediate 3 ft. 9 in., driving 7 ft. 0 in. Wheelbase, leading to intermediate 7 ft. 6 in., intermediate to driving 7 ft. 9 in. Total 15 ft. 3 in. Cylinders 16 in. diameter by 20 in. stroke. The grate area of the firebox was 15 sq. ft. but the number of tubes and the heating surface are quite unknown to the writer. The area for evaporating may have been about the same as the Tulk and Ley 7 ft. engines; it certainly could not have been more, for, although the firebox was of normal shape and, therefore, had a larger superficial area the boiler barrel was plainly cylindrical and not of double

segmental form, so the number of tubes must have been fewer.

In these Wilson built engines, Crampton firmly established the principle of adopting the double frames throughout, as he used in the *Liverpool*, and thus set a standard which was never departed from in the hundreds of Crampton engines built, under his patents, in France and Germany. Between these double frames the cylinders were bolted with their valve-chests on top. The valve-gear was Gooch's and the expansion links were actuated by the large eccentrics which we saw in the *Liverpool*. The reversing gear, as may be seen in the writer's drawings, was good mechanically, but theoretically bad. The reversing shaft, crossing over the top of the boiler, was carried in bearings on brackets bolted to the outer firebox shell, consequently any movement of the boiler longitudinally, by expansion, would cause the long vertical lifting links to move the radius rods up or down in the expansion links and to affect the periods of admission and cut-off. Obviously the setting of the valves would have to be done when the boiler was at its full working steam-pressure temperature; it could not be done with the boiler cold.

The regulator box on the boiler barrel was an ugly affair, but the chimney and safety valve casing were both of E. B. Wilson's standard patterns and were quite decorative; the former had a polished copper top whilst the other was a fluted iron casting, painted, and was surmounted by a polished brass bell-mouth with ornamental beading. The driving wheel splashers were of polished brass.

In 1852 the five Eastern Counties engines were renumbered, 233-237. They were painted green but no particulars are available of lining or picking out nor

(*Continued on page* 559)

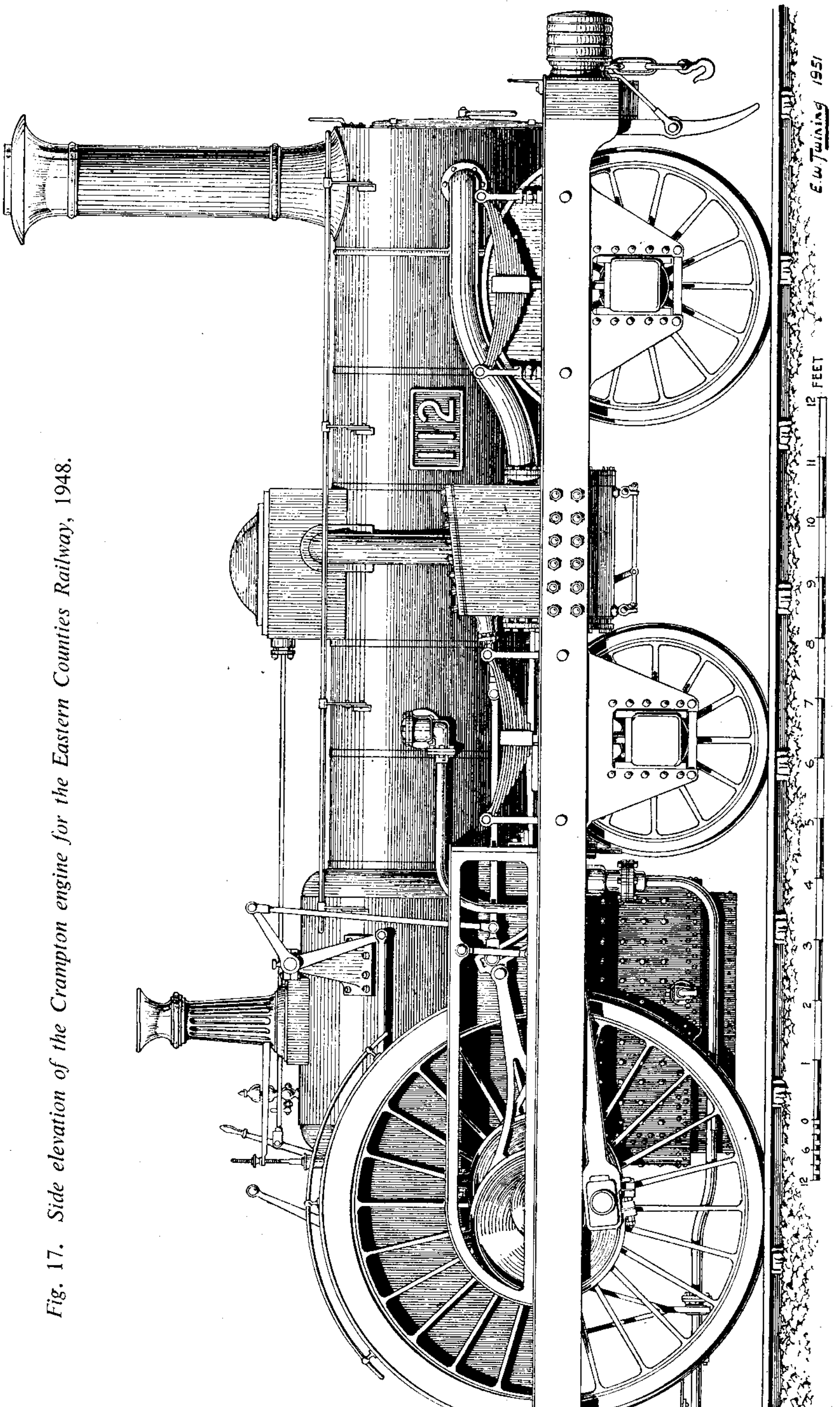


Fig. 17. Side elevation of the Crampton engine for the Eastern Counties Railway, 1948.

Surface Treatment of Metals

By C. G. Green, A.M. Inst. Mech.

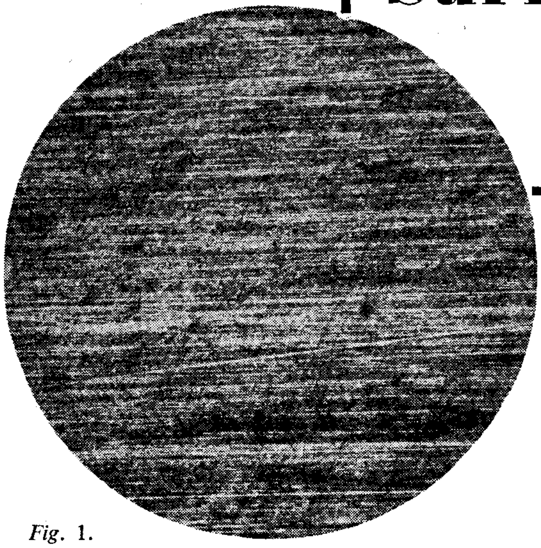


Fig. 1.

IN my recent article, " Making a Lens Adapter " published in THE MODEL ENGINEER July 16th, No. 2721, I mentioned that the adaptor was given a pleasing and durable finish by treatment in an M.B.V. solution for a period of three minutes. Several readers have writtent to ask for further details of this process, so I thought it would be a good idea to write a few words of explanation and at the same time give details of other useful metal surfacing processes.

During the last 25 years or so, considerable research has been carried out in the development of light alloys of magnesium and aluminium. Pure aluminium forms a natural oxide film, which proves resistant to further corrosion, but alloys such as duralumin that have the desired mechanical strength do not resist corrosion nearly so easily; consequently, a method had to be found whereby a protective film or coating could be formed on the alloy surface. The obvious method would be to paint the surface, but unfortunately it was found that paint would not readily adhere to the natural oxide film, it being smooth and hard. One of the methods developed was to etch the surface in order to provide a key for the paint; this was achieved by using a sulphuric/chromic acid bath, but as this mixture is strongly oxidising, the surface would again become oxidised if left in the bath too long. In fact, the immersion time is very critical, also the article has to be painted within a few minutes of removal from the bath, before the natural oxide film reforms. It is obvious that this method is far from easy to carry out.

By far the most successful method of surface treatment of aluminium alloys is that by which the natural oxide film is artificially thickened. I am sure readers will be acquainted with electrolytic anodising, whereby the article to be treated is made the anode in an electrolyte of either chromic, sulphuric or oxalic acid. This method produces very good results, but it has its disadvantages, necessitating expensive electrical equipment. Articles have to be very carefully degreased beforehand, and the electrolyte, being corrosive, causes a health hazard to the operator.

Chromic Oxidation

This method seems to provide

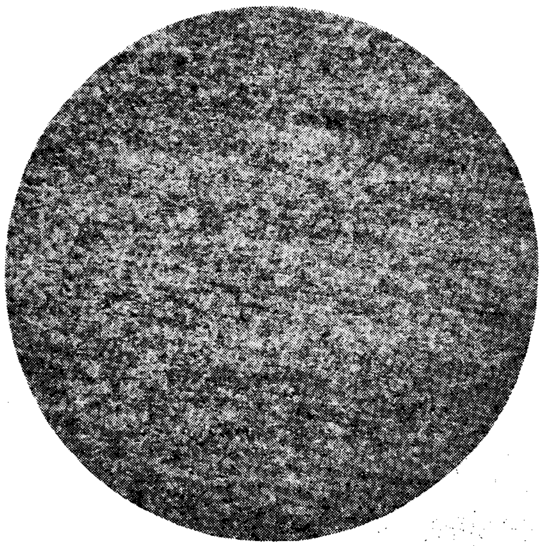


Fig. 2. *Surface of aluminium sheet after treatment with M.B.V.*

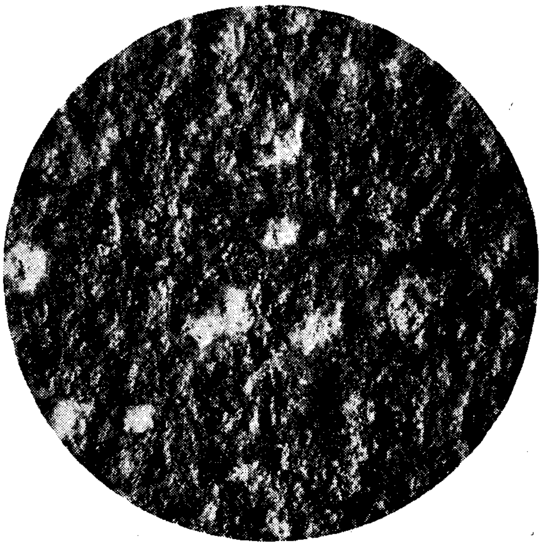


Fig. 3. *Steel surface coated with rust*

one of the simplest and cheapest ways of reinforcing the natural oxide film. Although not as hard as the surface created by the Anodic system, it is found to be more suitable as a paint base, having better absorption properties. Unpainted films by this method will not stand up to mechanical shock as will the anodic film, but all the same are fairly strong.

The original chromate-oxidation process invented by Bauer and Vogel is rather a complicated business, and so Echert devised a modification, known as the modified Bauer-Vogel process, or M.B.V. This method and variations are widely used in industry, but being so simple, it would be very easy for model engineers to operate a bath in their workshops. The article to be treated is cleaned, and immersed in a bath containing 5 per cent. sodium carbonate and 1.5 per cent. sodium or potassium chromate, which is maintained at about 90°-100° C., immersion time being from 3-8 min. By incorporating an organic dye in the solution, a range of coloured coatings may be obtained. Coatings obtained by such a process may be hardened by subsequent immersion in boiling water; a few drops of wetting agent, such as Teepol, added to the solution will help to give first-class results. The operation should be carried out in a glass, vitreous-enamelled, wood or steel container, zinc, galvanised or tinned iron tanks not being suitable. Or alternatively, for articles too large for immersion, a paste may be made by mixing 8 lb. of sodium or potassium chromate, 3 lb. anhydrous sodium carbonate, 3 lb. sodium hydroxide, making up to 1 gallon with water. This paste is applied for 10-15 min. and then washed off.

Figs. 1 and 2 are photomicrographs of an aluminium surface before and after treament with M.B.V. solution. It can be clearly seen that the metal surface is smoothed out, leaving only very small depressions which help provide a paint key.

The finish obtained is very attractive; it is shiny, and its colour varies from light grey to nearly black, according to the composition of the alloy.

Just a few words of warning; a considerable amount of gas is evolved during processing, and it is advisable to leave plenty of room at the top of the container, as otherwise the solution will froth over the top and make a nasty mess.

If readers would prefer to purchase the salts made up, The Walterisation Co. Ltd., Purley Way, Croydon, Surrey will be able to help them. Theirs is called the Walterisation " L " process. The salts are disolved in water, 7½ oz. to 1 gallon, and the article is immersed in this hot solution for a period of 4-8 min. The part is then rinsed in cold and then hot running water and finally dried.

Publication No. W/340 will give readers all the information required.

Fig. 4. Rusted surface after treatment with Deran

Protective Coatings for Ferrous Metals

Readers, I am sure, are well aware of the rust problems when dealing with ferrous metals. It is difficult enough to keep a painted steel or iron surface from rusting, let alone to remove rust once it is formed. Chemists have been working for many years on these problems, and have more or less perfected methods whereby rust may be prevented, and also removed once it has formed.

Model engineers working in their own time have a very simple rust remover at hand, i.e. hydrochloric acid. If a badly rusted surface, after first degreasing in trichlorethylene or carbon tetrachloride (Thawpit), is immersed in a solution containing 20-30 per cent. hydrochloric acid and an inhibitor; the rust will speedily be removed.

A word about inhibitors. These substances are included in the solution, in order to lessen the attack on the base metal, thus the article itself is not spoiled and the pickle is conserved; examples include foramalin, analine and diorthotolylthiourea. The amount used will depend upon the individual compound, but is usually of the order 0.1 per cent. After removal from the pickle bath, the article must be thoroughly rinsed in hot running water, in order to remove all traces of acid, and then dried. The derusted surface must be at once protected from further oxidation by painting, oiling or phosphating, the technique of which I will explain shortly. Now the above pickling process is quite alright where labour cost and the time factor is of no consequence. In industry, where these factors have to be studied,

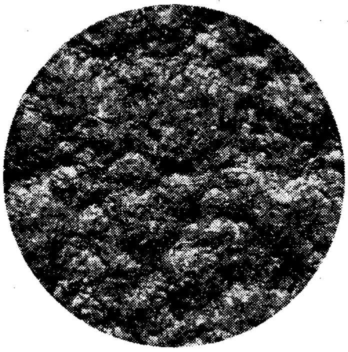


Fig. 5. Badly oxidised steel surface

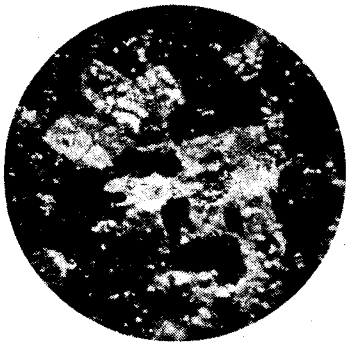


Fig. 6. After treatment with Deran type C

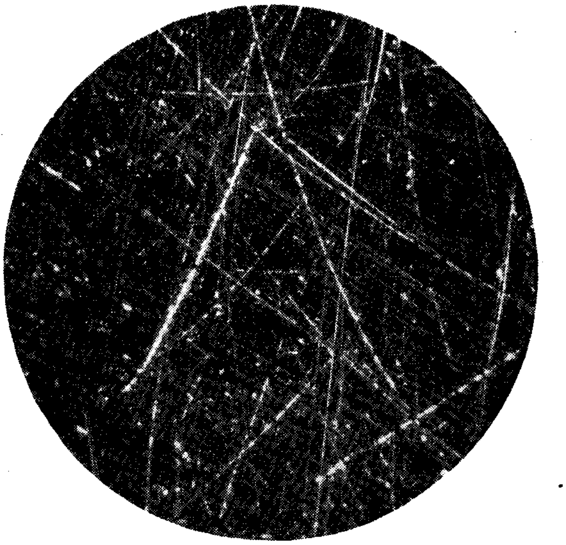


Fig. 7. Steel surface free of oxidation

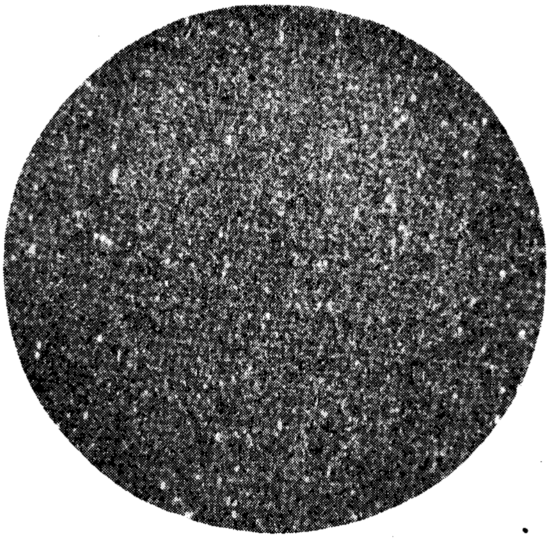


Fig. 8. Steel surface protected with a phosphate coating

other methods have been evolved, for instance, Deoxidine, made by I.C.I. or Deran, made by The Walterisation Co.; these pickles, in working condition, are essentially 20 per cent., v/v phosphoric acid containing certain active constituents. These solutions have certain distinct advantages over the hydrochloric method. Unless the grease film is very heavy, no treatment with carbon tetrachloride is necessary; also, the derusted surface is passive, so a long delay can take place between derusting and painting. Deran type " B " is for use when the article is small enough to be immersed in a tank containing the solution at about 50 deg. C. for 8-15 min. Deran type " C " is used cold, and is painted on and left for a period of about 30 min. and then rinsed.

Figs. 3 and 4 are of a very rusty surface before and after treatment with Deran. The white patches seen in Fig. 3 are large areas of raised rust that are completely removed by the pickle as seen in Fig. 4. Figs. 5 and 6 are of a similar rusty surface before and after treatment with Deran type " C," the lighter patches in Fig. 6 being bright metal, and the dark areas being depressions in the surface left after the removal of the rust.

When dealing with a new surface that has to be protected, or a derusted surface, phosphating is undoubtedly the answer. There are two main types of solutions used to produce this type of coating on a metal surface. First, a hot phosphating bath, immersion times and bath temperatures varying with the process, and secondly, a paint-on solution, used on fixed structures and articles too large for immersion baths. The functions of such coatings are twofold. First, to form a protective coating to prevent possible corrosion, and secondly, to produce a key for subsequent painting. In fact, manufacturers state that the phosphate coating produced by either method must be used in conjunction with a paint coating.

The effect of a phosphate coating may be readily tested by taking two identical metal plates, cleaning both to remove grease, treating one with a phosphate solution and subsequently giving each a coat of paint. On making a scratch on each and allowing to weather, often it will be observed that corrosion will spread quite rapidly from the untreated plate, whereas the spreading from the treated plate is extremely slow. In fact, this is a test frequently used by manufacturers in comparing relative qualities of coatings.

Phosphating Baths

(1) Walterisation " C1 " and Parker bonderising.
Immersion time 10-20 min.
Temperature 100 deg. C.

(2) Faster processes.
I.C.I. Granadine, Walterisation Fastbond and E process.
Immersion times 2-10 min.
Temperature varies 40-90 deg. C.

Fig. 7 is a photomicrograph of a new surface that has to be protected from oxidation. Fig. 8 shows the same surface after treatment with the Walterisation " E " process. It can be clearly seen that the nature of the surface has been completely changed, giving a " frosted " appearance.

Paint-on Solutions

These are essentially modifications of the immersion solutions, being more concentrated in acid, and containing wetting agents. There are a number of solutions on the market for ferrous metals, aluminium and galvanised articles. The methods of application are approximately the same. After degreasing and derusting (if already rusty) a thin coat of solution is applied and allowed to dry for 24 hours. It is actually dry after about 6 hours, but it proves advantageous to leave it a little longer. When dry it must be painted. Examples of these solutions are Phoscote RS for iron and steel, Phoscote AL for aluminium and Phoscote GA for galvanised material. Full information concerning these solutions can be obtained from The Walterisation Co. Ltd.

The author wishes to express his thanks to The Walterisation Co. Ltd., for their help in compiling this article, and to Douglas F. Lawson for his help by taking the photomicrographs for me.

THE ALLCHIN "M.E." TRACTION ENGINE

to 1½ in. Scale

By W. J. Hughes

REGARDING the casting for the compensating centre, Reeves has written to point out that he supplies this item in *malleable*-iron, not cast-iron as stated in the article dated July 16th.

This, of course, overcomes the objection of similar metals rubbing together, since malleable and cast-iron are of different textures, and the malleable casting should make as good a job as the gunmetal one—or even better.

Reeves further says that, in response to an overwhelming demand (as the theatre people put it) he is making the spud-pan and angle-ring in malleable iron, which is also an excellent idea.

Continued from page 376, *September* 24, 1953.

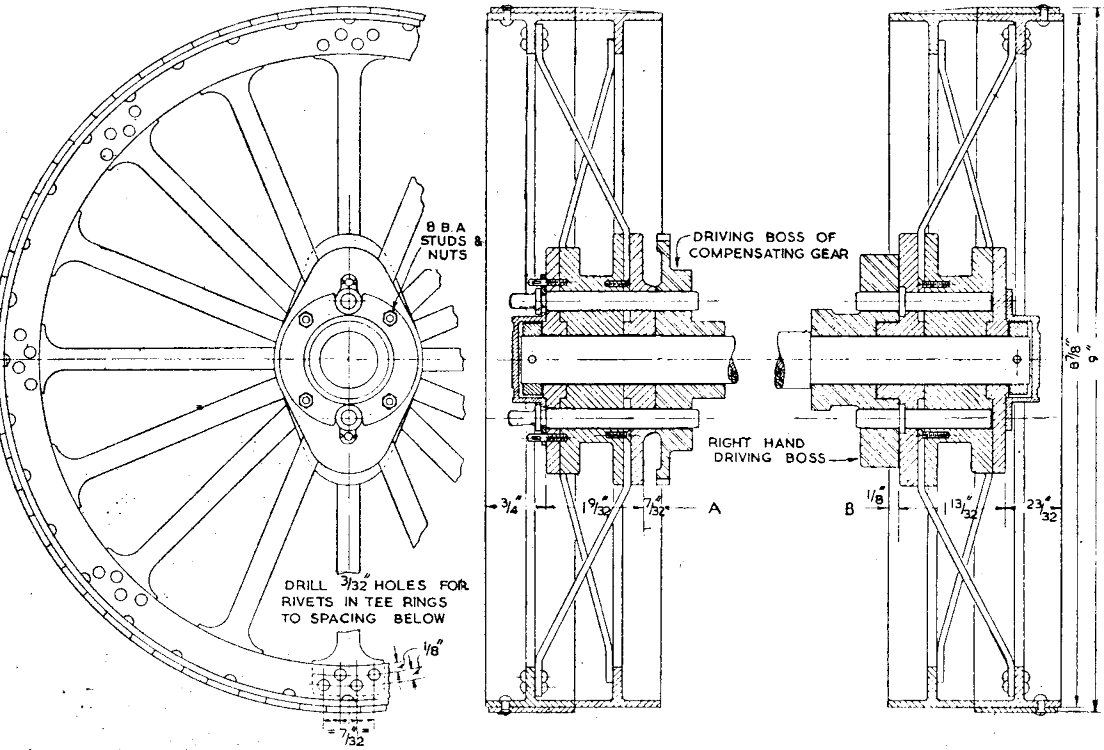
Right-hand Driving Boss

As we have seen already, the right-hand hind wheel is driven by means of two pins which pass into holes drilled in a driving-boss. The latter is keyed to the hind axle with a ⅛-in. square key, and is made from an iron casting.

Grip the casting in the three-jaw chuck by means of the smaller boss, and rough-turn the outer face and diameter of the driving-boss, use back-gear, of course.

Mount a boring-tool in the tool-post, and bore the cored hole out to be a good tight fit—but not a force fit—on the right-hand end of the hind axle. The tool should be a good stiff one, and the first cut should get well under the skin of the casting. Nor should you forget the precautions (mentioned in connection with previous boring operations) to avoid getting a "bell-mouthed" bore.

The next thing to do is to cut the keyway in the bore, and this is done as described before, so we needn't go into it again. After this, the boss may be finish-turned, and the work removed from the chuck.



Arrangement of hind wheels. Side elevation is of left-hand wheel: right-hand is similar, but driving pins do not project outside

Change the chuck-jaws for the outside ones.

Now grip the casting by the driving-boss, with the smaller one projecting, and, after rough-turning, finish to sizes given with a keen tool. The shallow recess between the two bosses is done with a round-nosed tool, of course.

Do not drill the four ¼-in. holes at this stage; they will be jig-drilled later from the hub of the wheel.

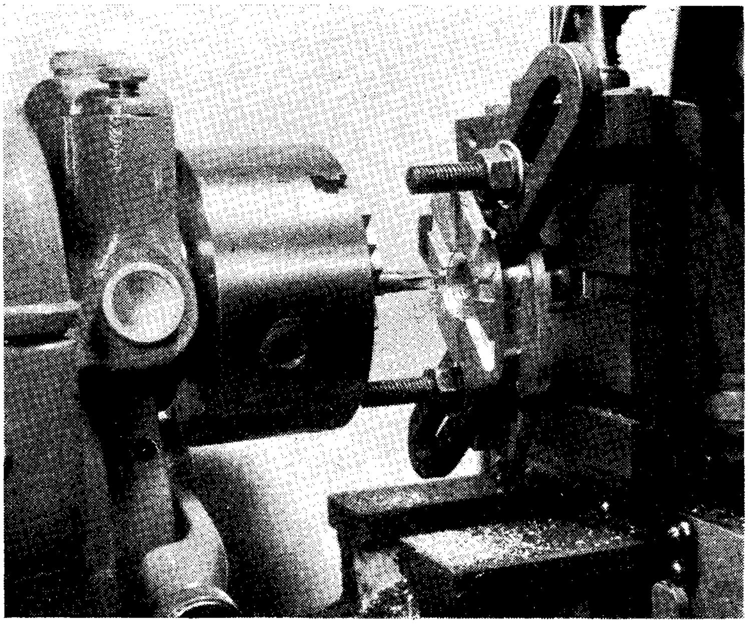
Construction of Hind Wheels

In the prototype, the hind wheel rims are made from two widths of tee-iron, formed into rings and forge-welded at the joints. They are joined together by the strakes, which are riveted on. The spokes are "palmed out" at their outer ends, and riveted to the vertical webs of the tee-rings, their inner ends being cast into the hub-bosses.

In the model, the tee-rings can be made in two or three different methods, which we shall deal with in due course. As to casting the spoke-ends into the hubs, this would be quite possible, but it would give Reeves' foundry-men a great deal of unnecessary trouble, and would not be so satisfactory to the builder as the method to be described.

The Real Thing

Briefly, the hub is made in three parts; an inner "bobbin," so to speak, and two end caps. Grooves are milled across the ends of the bobbin, or hub-centre, and the spoke-ends are fastened in these with countersunk screws. When the end-caps are fitted, and the whole sweated up, the result is indistinguishable from the real thing. Of course, this is an old and well-tried method—I don't know who was the originator, but good luck to him, wherever he is !



Photograph No. 47. Method of mounting hub-centre, and milling grooves for spokes

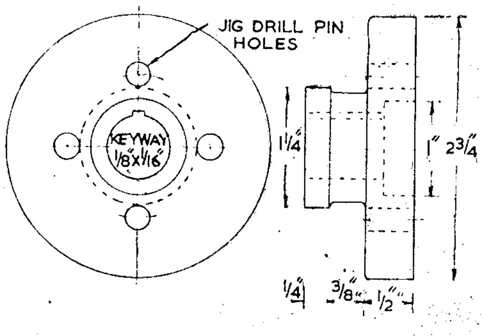
Incidentally, note that the two wheels are *not* identical; the differences include the thickness of the lobes of the hubs, the arrangement of the driving-pins, and the dimensions shown at *A* and *B*.

Left-hand Hind Hub-centre

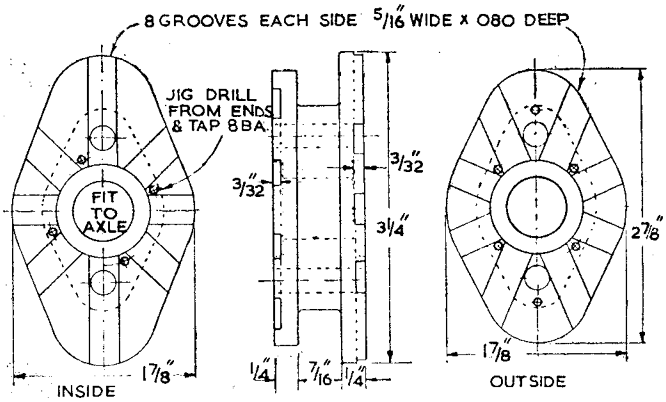
Since designing the hubs, and sending the drawing and specifications to Reeves, I have had second thoughs about the methods of machining, and so the chucking-spigots on the castings are no longer necessary, and can be sawn off.

Taking the left-hand hub first, clean up the castings with files, and then mount the hub-centre in the four-jaw chuck, setting it to run true. The larger (inside) end of the job should be outermost.

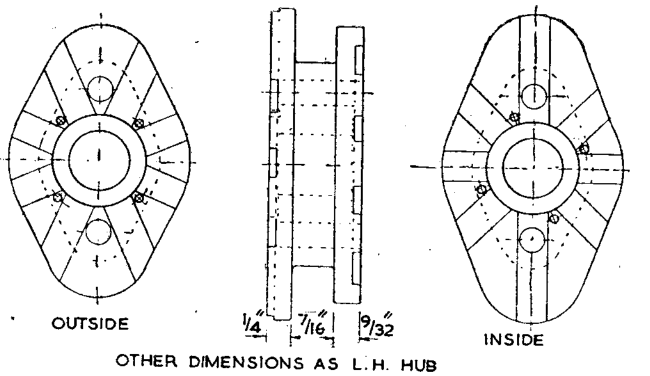
With a round-nose tool set crosswise, face back this end until the flange is a little more than ¼ in. thick. Centre the end with a large centre-drill, and drill through with successively larger drills up to ½ in. diameter. Now bore out the hole as you did the last component, but this time it should be a *running* fit on the *left-hand* end of the hind axle. That is, the axle should rotate freely, but without any shake, in the bore, so take your time over the fitting !



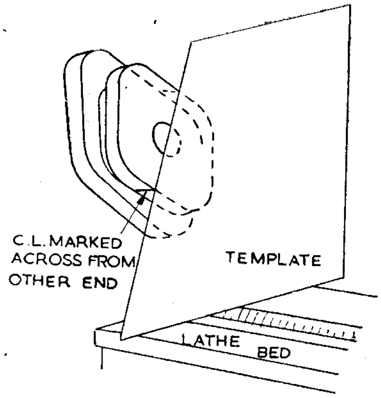
Driving boss for right-hand wheel.



Hub centre for left-hand wheel



Hub centre for right-hand wheel



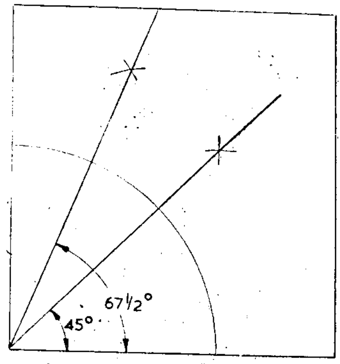
Using the template to set the work correctly

The flange is now finish-faced, with the thickness left at ¼ in. By the way, if the measurement between the two flanges of the centre is slightly more or less than the given dimension, $\frac{7}{16}$ in., this is not vital, but the thickness of the two flanges themselves should be adjusted to suit the overall dimension.

You now require a "sharp-cornered" boring-tool to counterbore the 1 in. diameter recess in the face, which should be taken to a depth of 3/32 in.

Mount your dividing attachment in the mandrel end, with a forty-tooth wheel on it set so that when the detent-screw is engaged, the major axis (or widest diameter, so to speak) of the hub-centre is horizontal. This can be tested with the surface-gauge, set to centre-height, used from the lathe bed.

Use the gauge to scribe a centre-line across the face; slacken the detent-screw, and turn the work through five teeth of the change-wheel: i.e., through 45 deg. Tighten the screw, and scribe another line across the face, but this time take it across the outer edges of both flanges also. This will be a help later on, as you will see.



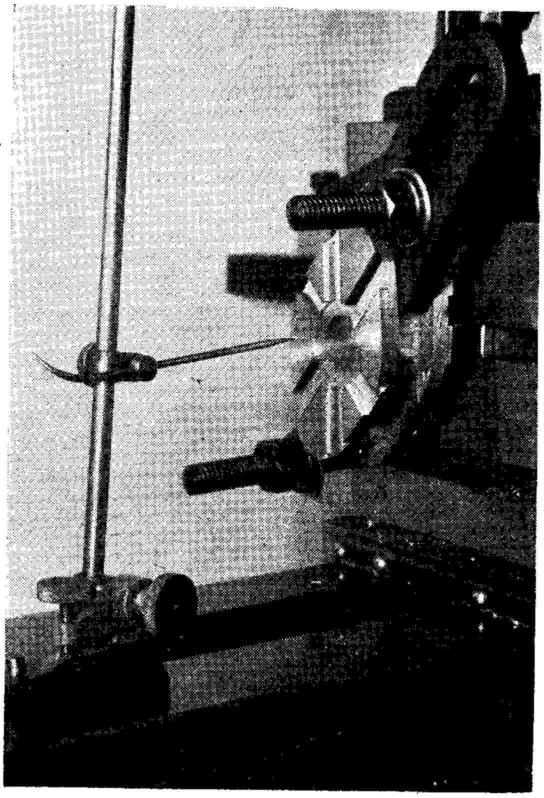
How to find the angle for the template

Turn the work through a further 45 deg., and scribe a third line across the face, and ditto repeato with a fourth line, which gives you the centre-lines of all the grooves to be cut across this face.

The Other Face

Reverse the work in the chuck, taking care that the machined face is pressed back hard against the chuck-face, and adjusting the jaws until the bore runs as truly as you can get it. Machine back the casting until the face is just $\frac{15}{16}$ in. from the inner one.

Now the 1-in. diameter recess is to act as a register for a corresponding spigot on the hub-end, and so even the slightest discrepancy will throw the bores of the components out of line. Hence it is advisable not to counterbore the recess on this side at present; it can be done later on, mounted on a plug-mandrel, which we shall have to make for the hub-ends. The grooves to be cut across this face have to be at 22½ deg. to those on the other face, but thanks to the lines we scribed across the edges of the flange, the new centre-lines are not difficult to scribe.



Photograph No. 48. Using surface-gauge to check if centre-line is horizontal and at centre-height

If you have a proper adjustable protractor or combination square, set it to 67½ deg., but if not, make a template to that angle, from tinplate or even cardboard, as sketched. With the base of the protractor or template on the lathe bed, set the work so that the lines on the edge of the flange come level with its sloping edge, as sketched.

Slacken the clamping-nut of the forty-tooth wheel on the dividing attachment, and use the latter to secure the chuck (and work) in this position. Re-check the accuracy before removing the template or protractor. If now you use the surface-gauge from the lathe bed, set at centre-height, to scribe a line across the face, it will be at the correct angle. All that remains to be done is to use the attachment, as on the other surface, to scribe the other three centre-lines across at 45 deg. to each other, and to remove the work from the chuck.

Jig for Milling Grooves

The hub-centre for the right-hand wheel is machined in exactly the same way, but note that the outside flange is thicker by 1/32 in. —i.e. the total thickness is 31/32 in. And when both centres are done, we must consider ways and means of machining the spoke-grooves, which are $\frac{5}{16}$ in. wide and 80-thous. deep.

They can be done in a variety of ways: on a planer, shaper, or milling-machine—vertical or horizontal, if you have any or all of 'em ! But if not, you'll have to end-mill the grooves in the lathe, as I did. And unless you are lucky enough to possess a rotary milling-table, you'll need a simple jig on which the work can be mounted, yet easily rotated without its centre being altered.

A Change of Mind

The sketch and photograph give the idea, although you will see from the latter that my jig differed from the one drawn. This was because I changed my mind about the method of mounting, but did not want to waste the jig already made.

To make the fitting, grip a stub of 1 in. diameter bar in the three-jaw chuck, and after facing the end, reduce its diameter to fit the bore of the centres, for a length of ¾ in. Part off at 1¼ in. long.

Reverse in the chuck, and reduce the other end to ⅜ in. diameter, to leave a collar of full diameter, as shown. Take a skim over this collar, and then screw the spigot ⅜ in. B.S.F., using a die held in the tailstock holder. Adjust the length of the spigot to be slightly less than the depth of the tee-slot on your vertical slide. File two flats on the shank as shown.

The nut is a short length of flat bar of breadth and thickness to fit the tee-slot, with a hole drilled and tapped ⅜ in. B.S.F.

Milling the Grooves

Mount the vertical-slide on the cross-slide, making sure it is square with the lathe axis; slip the jig-nut into one of the slots, and screw the jig in place, using a spanner to tighten it up. Don't be too ham-fisted, or you may damage the surface of the slide !

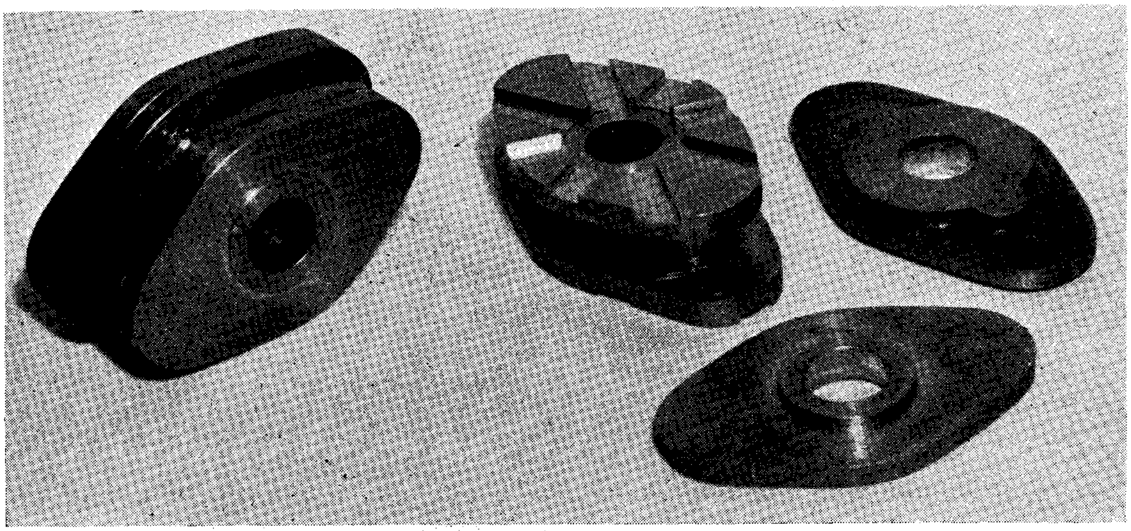
Put one of the centres on the jig, and set it so that one of the groove centre-lines is horizontal, using the surface gauge to do so. At the same time, you can set the centre-line to centre-height. This is done by setting the surface-gauge exactly to that height, and testing each end of the line from the lathe bed, adjusting the height of the vertical slide until both ends of the line coincide with the pointer of the gauge (see photograph).

Testing

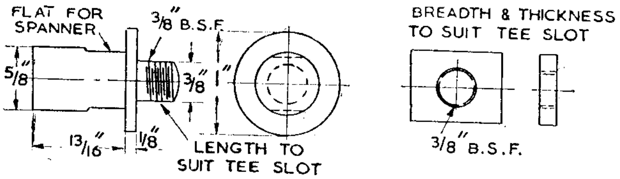
Clamp the work in position with a couple of dogs; the photographs show how mine was fixed. Test again with the surface-gauge to see that the centre-line is horizontal and at centre-height, and note the reading of the micrometer collar on the vertical-slide in case it gets moved accidentally.

The grooves are machined $\frac{5}{16}$ in. wide with an end-mill or slot-drill. If you haven't one of this size in stock, of course you should make one before setting-up to do the job ! " L.B.S.C." has described how to make 'em often enough, so I'm not going to bother here.

Grip the cutter in the three-jaw, and see that it runs true; if not, pack one or two jaws as necessary, (I'm



Photograph No. 49. Hind-wheel hubs completely machined—right-hand hub on left, and vice-versa



Components of milling-jig

lucky in that respect—the Burnerd-Myford chuck on my new "Super-Seven" runs dead true.) Bring the work up to the cutting-edges, and rotate the lathe by hand to see that the jaws clear the clamping bolts.

Set the lathe to run at fast speed, and traverse the work across with the cross-slide handle, taking off cuts of ten to fifteen thous. at a time until the required depth—eighty thous.—is reached. A piece of the 14-gauge steel for the spokes can be used as a gauge for depth if the lead-screw hasn't a micrometer collar, and should be used as a final check in any case.

When one groove has been milled to depth, slack off the dogs, turn the work until the next centre-line is horizontal, tighten the dogs, check centre-line again, and mill this groove to depth.

Repeat for the other centre-lines, and then turn the work over on the jig and mill the grooves on the other side. Finally, mill the eight grooves, four on each face, on the other hub-centre.

Wire Rope—and Steam Ploughing

I am pleased to say that my negotiations for supplies of suitable wire rope for the model have borne fruit, and by the time this appears in print, Reeves will be able to supply your needs. The rope will be in the correct nine-yard lengths, with the ends bound to prevent its unravelling. Incidentally, be very cautious when you undo the binding, as the ends easily fray out. *Verb. sap.*!

Readers will be interested to know that the rope is being specially made for us by a firm which in the past has made thousands of miles of rope for the full-sized engines. Even now they make a few odd lengths for ploughing sets and showmen, but gone, alas, are the days of yore, when the farms of East Anglia, the cottonfields of Egypt, the sugar-plantations of Cuba, and the grain-fields of Argentina echoed to the beat of those magnificent Fowlers as they grubbed and cultivated and trenched and ploughed.

Which reminds me that in my article describing the traction engines at the "M.E." Exhibition, and in talking about mole draining, I omitted to mention that in certain soils, usually clayey, the drain pipes are not used, since the drain will remain open for some time without them. But even there they are used in the drains which join the ends of the mole drains themselves. These pipes are laid in a trench, which may have been cut by the steam plough, or by hand; frequently the latter.

(*To be continued*)

BRITISH CRAMPTON LOCOMOTIVES

(*Continued from page* 551)

yet of the exact shade of green employed.

Of the North British Crampton, Mr. Hamilton Ellis in the second of his excellent and readable books: *Some Classic Locomotives*, tells us that No. 55 had the honour of pulling the train bearing Queen Victoria to Edinburgh, after she had opened the Royal Border Bridge, in 1860. For this occasion No. 55 was repainted, being elaborately got up in the Stewart Dress Tartan, with certain portions in green. In his third book: *Four Main Lines*, Mr. Ellis gives a coloured plate of the engine, reproduced from one of his excellent oil paintings.

If Mr. Ellis's arrangement of the big areas, on which tartan was painted, is correct, then the staff in the paint shops at the St. Margarets Works, must have had a tedius time, even if they used stencils.

Colour and Painting

The writer cannot refrain from saying that if he wished to build a model of No. 55 he would not paint tartan all over the plain surfaces, right to the edges; he would let the main colour be middle chrome green, put the tartan in broad bands around the boiler and in panels on the tender sides, outlining the bands and panels in black stripes with white lines on either edge. This seems to be the most reasonable and probable scheme. The long narrow frame members would then be plain green edged with black and fine lined white.

No. 55 ran for sixteen years in her original form and thus outlasted every other British Crampton. She was renumbered at successive intervals: 55A, 809 and 1009. In 1864 she was rebuilt as an orthodox 2-2-2 type with 6 ft. driving wheels, inside cylinders and a new boiler. In 1897 this veteran was given another boiler by Mr. Drummond and ran for a further ten years, finishing a wonderful career in the year 1907. Just how much of the original Wilson-Crampton remained after the 1864 drastic rebuild is a matter for speculation. There could not have been much beyond the carrying wheels, their axles and, it may be, the driving wheel centres with spokes cut down and re-welded to new and smaller diameter rims.

The writer wishes to acknowledge his indebtedness to his friend, Mr. L. Ward, for the loan of a drawing, made many years ago, by Mr. Cosgrave; which drawing has been largely used, by the writer, in the preparation of Fig. 17.

★ *Our Cover Pictures*

Readers of *THE MODEL ENGINEER* are invited to submit for consideration photographs which may be suitable for cover pictures. The subject must be within the scope of this journal and reference to the covers of this year's issues of the "M.E." will give an indication of the type of photograph preferred. If accepted for publication, a reproduction fee of two guineas will be paid.

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THE MODEL ENGINEER
19-20 Noel Street
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